REVIEW AND SELECTION OF SUITABLE

DATA MANAGEMENT APPROACH AND PRODUCTS

FOR

ALMRS/GIS AND LIS/GIS APPLICATION PROTOTYPES

JULY 25, 1986

ALMRS-GIS PROJECT OFFICE

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To: All State Directors
Attention: Associate State Directors

From: Service Center Director

Subject: Review of Data Management Products for ALMRS Prototype

A review of data management approaches and products has been made to select a product for immediate use in the ALMRS-GIS prototype activity in Denver and the Land Information System demonstration in New Mexico. Reviews were held in the Service Center and in the ALMRS-GIS subcommittee of the Field Committee.

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1. EXECUTIVE SUMMARY

The purpose of this report is to recommend and select a data management approach for the immediate use by the ALMRS prototype and GIS in Denver, and the Farmington Demonstration Project in New Mexico.

This report is recommending the use of ORACLE, a relational data base management system.

This report addresses the first two stages of a three stage data management decision process. First, data management software is needed for prototyping and development of contract specifications (RFP) for the Bureauwide System between now and the summer of 1987. The object during this very short period is to verify design concepts including: concurrent updating, portability of data systems, and validation of acceptable levels of usability for the client end-user and system design concepts. This activity will take place in Denver (SC) and New Mexico.

A second stage and need is the interim use of data automated for the ALMRS and GIS applications. Data now being automated can be utilized to the Bureau's benefit between data acceptance and Bureauwide implementation/ operation of the ALMRS and GIS systems. The prototype hardware and other computers acquired through the GIS procurement can be used for several years, 1987 through implementation of whole systems in 1990-1992. The RDBMS recommended for the prototype work can continue to be used during ALMRS development on prototype and other available computers.

This report anticipates requirements for the third stage; Bureauwide implementation and operation of the ALMRS GIS Systems and other systems. However, no constraints on selection of data management products for general operations is intended at this time.

The methodology used to select a data management product for prototyping included analysis and use of the FEDSIM Alternatives Analysis (4) for ALMRS, review of prototype documents (1)(5)(6), involvement in the prototype/LIS planning a literature review and interviews. A National Bureau of Standards publication (7) about choosing a data management approach defines the general approach.

Data management approaches, (1) Traditional Application, (2) Data Management System DMS, and (3) Data Base Management System DBMS are defined and described in Section 3. Sections 4 and 5 apply ALMRS and GIS prototyping requirements (a GIS feasibility study is now in progress) to the three approaches. The DBMS approach is a software system allowing multiple independent users concurrent access to share data. A data base consists of interrelated sets of data stored together with controlled redundancy to serve multiple applications. A DBMS provides query, report writing and data update procedures to users logically without need for knowledge about the physical access procedures. The relational DBMS has been introduced in the last ten years and is more end-user oriented than other types.

A relational DBMS is required to provide flexibility for use by non-programmers using free form methods. Relational DBMSs are often implemented with another required feature, a fourth generation language (4GL). A 4GL is generally defined as a command set (words, menus) that gives users integrated capabilities including: queries, reporting, graphics, statistics and modeling that can be implemented through simple syntax which makes processed data accessible to nonprogramming users. The prototype may add a "user-friendly" end to the vendor product for testing.

The real objective in prototyping is a combination set somewhere between requirements testing and validation, defining contract specifications and a miniature system which can have utility for processing data being automated pending full implementation of ALMRS and GIS Systems. Specific objectives include reduction of risks, e.g., failure to fully define/meet requirements, and validate system design concepts. Design concepts to be tested include: portability of operating system and required application software to different computers (vendors and sizes), user interfaces and integration of alphanumeric attribute and spatial position data. Application development tools in DBMS products are crucial to testing during the next year. Development aids are considered heavily relative to demonstrated production speed which will be important in selecting a production system DBMS.

Section 6 reports the results of comparing about 270 products, and more specifically 54 DBMS products. Capabilities and features required for prototype work and available computers are set out as 26 pass/fail selection tests. Each test is referenced to the requirements factors in Sections 4 and 5. Table 6.1A in Appendix A shows required features (columns) and products (rows) and is used to rank the products. The number of failures in meeting requirements was determined and products ranked from low failure to higher failure rates. Although complete information is lacking for some products, this is not fatal to the analyses since good information is available for other failures to meet requirements. Failures on the 26 feature/capability tests ranged from 0 to 24.

The requirements for the prototype application DBMS are very different than for the microcomputer DBMS standard set by the Bureau in June, 1986 (9). Deficiencies identified in Table 6.1A, production versus development, training and computer size requirement differences substantiate the validity of not selecting the microcomputer DBMS standard, dBase III.

Two concerns remain on the selection process. First the comparative information about application development tools could be explored further. Secondly, information on ease-of-use by end users who are not programmers is often shrouded in marketing-type language.

Decision Issues:

* Should ALMRS select ORACLE for prototyping and expand its use to other prototyping sites and phases including LIS and GIS?

  - o The requirements show the need for an RDBMS.
  - o ORACLE is the only RDBMS to pass all of the requirements.
  - o The costs of ORACLE are comparable to other candidates.

  Recommendation: Use ORACLE for prototyping.

* Can ORACLE serve data management needs for the interim period prior to implementation of ALMRS and GIS where:

  - o Use of ALMRS-GIS interface prototyped in Farmington can continue.
  - o Prime computers used in Farmington which may be acquired at several Bureau sites and the prototype software used with little or no change.

  An affirmative decision on interim data management can be confirmed after successful DBMS-GIS interface prototyping.

A summary of the requirements and five leading contenders, developed in Section 6 as Table 6.1, is shown below:

Comparison Features and Requirements for Prototype Activity: ALMRS-GIS-LIS

					NAME OF DATA BASE PRODUCT					No of DB
					FOCUS	INGRES	ORACLE	SIR/DBMS	UNIFY	Passing Rqmnts (out of 54)
REQUIREMENT										
Sec.	Reference	Mandatory =	Y	No.						
5.0	DBMS		Y	1	Y	Y	Y	Y	Y	54
5.1	Hardware Prototype	HP9000/320	Y	2	—	Y	Y	Y	Y	3
5.1		560	Y	3	—	—	Y	Y	Y	3
5.1		DEC Micro VAX II	Y	4	Y	Y	Y	Y	Y	2
5.1		Prime 2450 "D"	Y	5	—	—	Y	—		1
5.1		9750 "B"	Y	6	—	—	Y	—		1
5.1		9955 "A"	Y	7	—	—	Y	—		1
5.1		IBM PC/AT Compatible	Y	8	Y	Y	Y	Y	Y	1
5.2	Software:									
5.2	Oper. System: UNIX/UNIX-like		Y	9	Y	Y	Y	Y	Y	10
5.2	Fourth General Language		Y	14	Y	Y	Y	Y	Y	15
5.4	Performance:									
5.4	Monitoring with System Accounting		Y	10	Y	Y	Y	Y	Y	46
5.4	Concurrent On-line and Batch		Y	11	Y	Y	Y	Y	Y	48
5.4	Concurrent Appl'n Program Access		Y	12	Y	Y	Y	Y	Y	48
5.5/5.2	Program Maintance:									
	Fourth Generation Language		Y	14	Y	Y	Y	Y	Y	15
5.5/4.7	Data Org/Reorganize: Relational DBMS		Y	13	—	Y	Y	Y	Y	25
		Relation-like		13	Y	—	—	—	—	2
5.6	Query: Data Base Language: SQL		Y	15	—	—	Y	Y	Y	6
5.6		SQL-like		15	Y	Y	—	—	Y	6
5.6	Inquiry Retrieval Facility		Y	16	Y	Y	Y	Y	Y	50
5.6	Report Generator		Y	17	Y	Y	Y	Y	Y	49
5.7	Security		Y	18	Y	Y	Y	Y	Y	50
5.7	Recovery Checkpoint/Restart		Y	19	Y	Y	Y	Y	Y	48
5.7	Logging		Y	20	Y	Y	Y	Y	Y	47
5.8	Data Dictionary		Y	21	Y	Y	Y	Y	Y	45
5.9	Business Graphics Facility		—	22	Y	Y	Y	Y		6
5.10	Screen Interface - 4GL		Y	23	Y	Y	Y	Y	Y	9
4.1	Micro/Mini Link Interface		Y	24	Y	Y	Y	Y	Y	39
4.1	Telecommunications Interface		Y	25	Y	Y	Y	Y	Y	48
4.1	Data Import/Export		Y	26	Y	-	Y	-	Y	6
	Number of Requirements Failed				7	7	0	5	5	

2. PURPOSE AND APPLICATIONS

The purpose of this review of data management approaches and products is to isolate candidates and recommend a product for use in the Automated Land and Mineral Record System (ALMRS) prototype, the Land Information System (LIS) demonstration in Farmington and Geographic Information System (GIS) prototyping.

ALMRS prototyping includes several alphanumeric data bases, including status, land description, and master name. Several of these bases involve spatial data and require a coodinate data base.

LIS data includes alphanumeric and coordinate data in common with ALMRS and additional cultural and resource data themes with alphanumeric and coordinate data bases relevant to processing Application for Permit to Drill (APD).

AALMRS, Alaska ALMRS, previously known as the Alaska Automated Land Records System, is acquiring a new computer pending conversion to ALMRS in the early 1990s. Use of the same DBMS by Alaska and ALMRS could significantly facilitate data conversion to ALMRS.

Both ALMRS and LIS will require use of the Geographic Information System (GIS). Candidate GIS software packages include the Map Overlay Statistical System (MOSS) and related programs which are now in use in the Bureau and proposed for use in LIS. The selected DBMS will be interfaced with one or more spatial data processing systems during ALMRS prototyping and the LIS demonstration. The ALMRS prototype is now testing two graphics systems; "Digical" by HASP Graphics, Inc., and the "Land Information System" by Geographic Information, Inc.

3. DATA MANAGEMENT APPROACHES

The demand for new and improved computer applications in the Bureau, and specifically the Automated Land and Mineral Records System (ALMRS) and the closely related Geographic Information System (GIS) requirement, involves examination of data management approaches. This examination is one part of a broader review of data processing requirements for the ALMRS-GIS applications, which also involve examination of new ways for designing user interface methodology, programming languages, computer hardware, communications, and operating systems.

The purpose of this section is to provide a context for the selection of a data management approach and the subsequent selection of software packages appropriate to meet ALMRS-GIS requirements. More specifically, a data management package is needed for prototype development and as a test base for defining/determining specifications for a Request for Proposal (RFP) for the development of ALMRS. Much of the material in this section is derived from the introductory section of Guideline for Choosing a Data Management Approach (7).

One can view the various data management approaches as a spectrum ranging from traditional application system (file oriented, usually in COBOL) to database management system (an integrated, shared data resource utilizing data dictionaries, query languages, report writers, telecommunications

software, and other features). The following three major data management approaches are described and analyzed:

- Traditional Application System (file environment);
- Data Management System (DMS) (file environment plus); and
- Database Management System (DBMS).

This background section focuses upon these approaches because they represent the major strategies now being used for data management.

Each data management approach is supported by a large number of commercial software packages. For the Traditional Application System approach, virtually all large-scale computer, minicomputers, and most microcomputers have COBOL and other high-level language compilers. The DMS and DBMS approaches represent hundreds of individual application packages. DMSs are available on all sizes of computers, and are currently very popular on microcomputers. DBMSs are commonly found on mainframe and minicomputers and, in the last five years, on many microcomputers.

One of the most serious and costly problems in data management is the lack of correspondence between user requirements and appropriate data management approaches. The most costly aspect is not the purchase price of a particular software tool or tools, but the investment in application programs that may not meet user requirements. By providing a framework for the manager to analyze various data management approaches, the section provides information narrowing the number of data management software tools that must be reviewed in choosing the appropriate tool or tools to meet organizational requirements.

Figure 3.1 shows how two representations of growth, the data processing (DP) organization and the data storage environment, and the data management approaches might compare. Bureau DP facilities and Bureau management have reached at least Nolan's third stage of growth for data processing organizations and Martin's Class B of data environment (see Figure 3.1) along with most federal agencies. This document proceeds to address the evaluation, selection of a data management approach, and specific solutions.

3.1 Traditional Application System

The Traditional Application System data management approach invovles the development of specially designed application software programs. These software programs provide all the needed application functions, and are usually written in COBOL, FORTRAN, or another high-level programming language. Data records having simple and common formats are combined into distinct files. The programming staff develops each application separately, working out program logic and file designs that seem convenient and effective for the specific required processing. The programming staff must be aware of the appropriate file access methods, and must support relationships between files by special programming procedures. Most applications using the Traditional Application System for data management rely heavily on batch mode.

3.2 Data Management Systems

A Data Management System (DMS) approach can be characterized as a compromise between the Traditional Application System and the DBMS approaches. There really are many different approaches in the spectrum between these two approaches. The DMS approach described here occupies a portion of that spectrum, and has its roots in the

G R O W T H	M O D E L S	
DATA PROCESSING ORGANIZATION	DATA ENVIRONMENT GROWTH	DATA MANAGEMENT APPROACH
Stage I (Initiation) (Mid-1950s*) First Computers - Financial Management, Forestry	Class A (Files) (Mid-1950s - 1980s) - Separate files used by most applications - Proliferation of files with high levels of redundancy - Trivial changes can result in unexpected ripple effects throughout the data files	1. TRADITIONAL APPL. SYSTEM (Mid-1950s - 1980s) - Use of specially designed applications software programs - Applications are separate - Most applications are batch
Mid-1960s Stage II (Contagion) - High-level management accepts computers - More users have programs developed		
Stage III (Control) (Late 1960s) - Processing volume requires management to enforce actively system planning control - Trend to centralize control	Class B (Appl. Data Bases) (Late 1970s - 1980s) - Application data bases developed using data management, and data base management systems are used without sharing of data - Separate data bases are implemented for separate applications	2. DATA MNGMT. SYSTEM (DMS) - Provides some programming/user tools of DBMS - Integrated data sharing may not be provided - Primarily intended for single application
Stage IV (Integration) (Mid-1970s) - Acquisition/use of tools which are more user-oriented - Existing applications often retrofitted using DBMS technology	Class C (Subj. Data Bases) (Mid-1970) - Data bases created which are largely independent of specific application - Data defined and stored independent of the function for which it is used	3. DATABASE MANAGEMENT SYSTEM (DBMS) (1978 -) - Software system allowing multiple independent users concurrent access to a shared data base - Consists of interrelated sets of data for multiple applications without redundancy for multiple applications - Provides controlled approach for adding, modifying, and retrieving data - Provides access logically without user knowing physical access - Packages provide complete set of integrated tools along with basic DBMS including: data dictionary, teleprocessing monitor, query facility, report writer, application development facility and special purpose applications which make DBMS easier to use - Data organization can be restructured without unloading and reloading - Relational DBMSs can dynamically restructure for flexible integration of data from various sources - Most DBMS implementations provide concurrent batch and on-line processing of data - DMS packages can now be effectively implemented on all sizes of computers including micros
Stage V (Data Admin.) (Mid-1970s - 1980s) - Distinguished by establishment of data control function with integration of applications and shared data	Class D (Infor. Systems) (Mid-1970s - 1980s) - Data bases organized for searching and fast information retrieval rather than high-volume production runs - May coexist with Class C	
State VI (Maturity) (Late 1980s) - Occurs where application software integration mirrors information flows - User community accepts greater responsibility for design and operation of applications growth		

Figure 3.1. Comparison of two models of growth: data processing organization growth and data environment, with the three data management approaches.

* Dates are estimates of Bureau progression.

Traditional Application System approach because it relies on a file approach. A DMS approach generally provides fewer additional tools than the DBMS approach. One major difference between DMS and DBMS approaches is that the DBMS approach supports integrated data sharing without redundancy for multiple applications. The DMS approach may not provide for integrated data sharing or may provide less data sharing capability than a DBMS. The DMS approach is primarily intended for a single application.

Some DMSs come combined with various tools. Other DMS approaches require the user to mix and match tools to accomplish the desired functions.

There are many DMS-type packages available for users on microcomputers. Vendors of these DMS packages prefer to call them "database management systems" or "data managers."

3.3 Database Management Systems

A DBMS is a software system allowing multiple, independent users concurrent access to a shared database. A database consists of an interrelated set of data stored together with controlled redundancy to serve one or more applications. The DBMS provides a controlled approach for adding new data, and for modifying and retrieving existing data within a database. The DBMS approach provides a degree of data independence in that the data can be accessed logically without knowing any special physical access method procedure supporting the data access (7) .

Today DBMS vendors have provided a complete set of integrated tools along with the basic DBMS package. These tools include data dictionary, teleprocessing monitor, query facility, report writer, application development facility, and special-purpose application packages built upon the DBMS. Integrated tools can make the DBMS environment much easier to use. The provision of integrated tools is still relatively new.

In the middle 1970s, users had a choice of two major categories of DBMSs: data-processing-oriented DBMSs and end-user-oriented DBMSs.

(1) The data-processing-oriented DBMS, exemplified in the CODASYL DBMS specifications, did not provide query facilities and required a fair amount of expert knowledge about the DBMS package. The data-processing-oriented DBMS provided rich data organization structuring capabilities, and performance could be tuned by choosing access methods and physical storage strategies most appropriate for the application.

(2) End-user-oriented DBMSs, characterized by an inverted file access technique, are very good at extracting a small amount of data (usually much less than 5%) from a large database and quickly presenting the results to the user. End-user-oriented DBMS's users had a query/update langauage to obtain the information of interest and produce reports. Although data updating could be handled with the query/update language, updating in early DBMSs was done typically with a batch program that performed the updating overnight for processing efficiency. End-user-oriented DBMSs also provided some ability to add or delete data fields without unloading and reloading the exiting database.

From the middle 1970s until now, DBMS vendors have maintained the existing functionality of their products while adding additional capabilities. Data-processing-oriented DBMS vendors have added their own query/update facility which was a large step in improving end-user access to the data in the DBMS.

Within the last few years a new type of DBMS, a relational DBMS, has become available in the marketplace and offers more characteristics of an end-user-oriented DBMS than a data-processing-oriented DBMS. However, a relational DBMS also provides a dynamic structuring capability that provides flexible ways of integrating data from various sources. Both data-processing-oriented and end-user-oriented DBMS vendors have added some of these relational tools.

Today, although DBMS packages may appear to have externally similar capabilities, end-user-oriented DBMSs are still best in data retrieval; and data-processing-oriented DBMSs are best in data structuring, data sharing, and performance-tuning capabilities. Their vendors offer packages available for mainframe, minicomputers, and microcomputers.

4. GLOBAL FACTORS FOR SELECTING A DATA MANAGEMENT APPROACH

Generic considerations applicable to all data processing facilities are applied to the emerging ALMRS-GIS applications to isolate an appropriate data approach: Traditional, Data Management System (DMS) or Data Base Management System (DBMS).

4.1 Data Sharing

When applications will require multiple programs to have access for the same data concurrently data sharing is necessary.

The Traditional Application Approach to data sharing usually involves duplication of the shared data in files. Data processing efficiency measures can include duplication of all or parts of one to many files. Conflicts can arise when file additions and updates results in different data in the different files when immediate updates are not made to all files. Mechanisms for immediate data sharing without redundancy are not available using the Traditional Application System. The Traditional Approach is most effective when:

- Applications use the same files without requiring combinations, or subsets of existing files.
- Users are not concurrently updating data.

The DMS approach utilizes files, although some implemented systems provide limited assistance in managing data sharing. This approach is most effective when:

- Using files and requiring some combinations or subsets of existing files.
- Users are not concurrently updating data.

The DBMS approach includes mechanisms for managing data sharing without by providing each user with a view of a single centralized data resource which can be accessed and updated concurrently by all users. This approach is most effective when:

- Applications require a variety of combinations and subsets of the data resource.
- Simultaneous updating of data files is required.

The ALMRS Feasibility Study and prototype documents define extensive data sharing requirements between major kinds of data, e.g., status, land description, and stipulations and subsets of these, e.g., case lands, action, etc. Although many kinds of data will have a large static base, all are subject to variable rates of additions and updating. For ALMRS, this factor is best satisfied by the DBMS approach. ALMRS spatial graphics, e.g., position data (coordinates) and related GIS applications will also require extensive data sharing.

Selecting the DBMS approach can solve many problems at each operating site. However, the ALMRS Feasibility Study develops a configuration of computers distributing processing and data to 146 Area Offices (AO), 53 District Offices (DO), 11 State Offices (SO), and the Denver Service Center (national aggregate) and data use by the Washington Office (WO). When colocation of offices is considered, this is 136 separate sites. (Counts exclude Alaska which is now included and adds 4 sites.) Some of the data will be duplicated at multiple sites for (4) page 93:

- Intensive use by the land and case managing/administrative office.
- Protection against catastrophic physical loss.
- Communications and other cost savings.
- Improved performance.

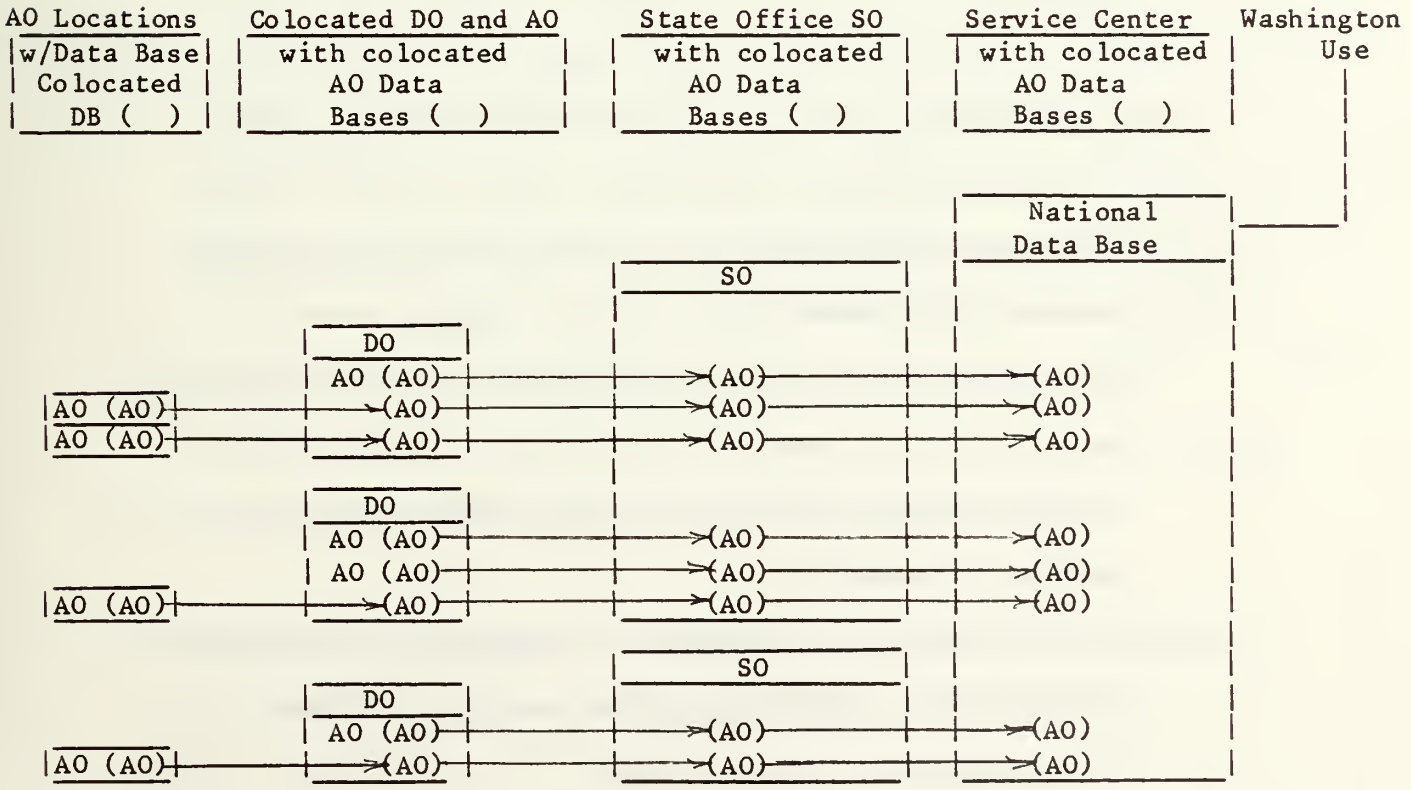

Figure 4.1 - Distribution/Colocation of Offices and Data

The prototype will have to address data sharing between computers and copies of data at different sites. This factor will be complicated by the fact that changes to most kinds of data, e.g., status cases, can originate from Area, District, and State Offices and many updates will require extensive edit processing.

4.2 Data Use Patterns

The anticipated data use pattern for an application and appropriate data management approach selection in notes estimates for:

- Relative numbers of outputs reports and queries known in advance and ad hoc/unique output requirements.
- Modes of use.
- Access (response) time (delay between making request and receiving output product).
- Accesses for updates as a percentage of total accesses (including outputs).

The Traditional Application System is most effective when:

- Requests for information and reports are generally known in advance of the need.
- Data processing operations and outputs are predominately batch mode.
- Access, and processing time, is not immediate (days rather than minutes or seconds).
- Tends to provide poor interactive response due to the lack of a flexible query capability and the lack of a built-in teleprocessing interface program.

The DMS and DBMS approaches are most effective when:

- Requests for information and reports are not generally known in advance.
- Data processing operations and outputs are predominately an interactive and on-line mode.
- Access time requirements are short; e.g., user waiting for information before work can continue.
- The majority of data accesses are for data retrieval as opposed to update requests.

ALMRS requirements drawn from the FEDSIM Alternatives Analysis corresponding to these four use patterns are summarized here:

- Only 56 per cent of information request transactions are known prior to the request. (See Table 4.1.)
- Interactive on-line transactions make up 98 percent of the access. (See Table 4.2.)
- Access times are short. Interactive use transaction turnaround cycle time varies from 1 to 15 minutes with computer response requirement ranging from 15 to 30 seconds. (See Tables 4.3 and 4.4.)
- Approximately 5 percent of the transactions are update/data change whereas 95 percent are for use of retrieval information.

Requirements for data use are discussed and quantified for ALMRS on the Alternative Analysis (Feasibility Study) activity levels in 1985. (See Table 4.5.)

A large percentage of the information accesses will be ad hoc and retrieval format will not be known precisely until the request is made.

Table 4.1 Estimate of Information Requests Known in Advance of Need (4) page 125.

Transaction per day By Function	Mode						Total No. Known in Advance
	Interactive			Batch			
	Total	Known in Advance		Total	Known in Advance		
		Pct	No.		Pct	No.	
Case Processing	22,977	20	4,595	384	100	384	4,979
Query	174,386	60	104,632	0	100	0	104,632
Management Reports	1,992	50	996	4,000	100	4,000	4,996
Subtotal	199,355			4,384			
Known in Advance Number			110,223			4,384	114,607
Percent		55			100		56

The mode of use is also estimated in the FEDSIM report.

Table 4.2 Use Pattern Transactions Per/Day (4) page 125.

Transactions Per Day by Function	Interactive/On-line		Batch		Total	
	Alpha	Graphic	Alpha	Graphic	Alpha	Graphic
Case Processing	21,477	1,500		384	21,477	1,884
Query	107,314	67,072			107,314	67,072
Management Reports	1,992	--	4,000	--	5,992	--
Subtotals	130,783	68,572	4,000	384	134,783	68,956
Interactive Total	199,355	98%			66%	34%
Batch Total			4,384	2%		
TOTAL					203,739	

Response times requirements by function are included in the Feasibility Study and are shown below.

Table 4.3 Required Turnaround/Response Times in Minutes (4) pages 56, 119

Function/Transaction	Turnaround Cycle (Request - Response)			
	Alphanumeric		Graphic	
	Average	Maximum	Average	Maximum
Case Processing				
Application Verification	5	10	5	10
Land Availability, Verification	1	1	5	10
Quality Control Check	1	1	5	10
Query	5	10	1,080	1,440
Management Reporting	30	1,440	N/A	N/A

Table 4.4 Turnaround Cycle, Minutes by Step, for two Iteration Cycle of Interactive Access, (4) page 119.

Iteration /Step	Transaction Type by Step Minutes		
	Alphanumeric		Graphic
	Case Processing	Query	Case Processing & Query
1. Think/Formulate	1	1	4
Input	1	6	1
Computer Response Time	0.25	0.25	0.5
Review/Edit	1	1	2
2. Think/Formulate	0.5	0.5	2
Input	0.5	0.5	1
Computer Response Time	0.25	0.25	0.5
Review/Edit	0.5	0.5	4
Total	5	10	15

Accesses for data for updating/change purposes is estimated to result from one-third of the interactive case processing accesses for alphanumeric data and one percent for graphics (coordinate position data).

Table 4.5 Update Transactions Per Day (4) page 125

Function/Data Type	Total	Interactive Transactions	
		Percent Updates	No. of Updates
Case Processing			
Alphanumeric	21,477	33	7,087
Graphic	1,884	1	19
Sub Total	23,361		
Weight & Average		30.4	7,106
Query			
Alphanumeric	107,314	-	0
Graphic	67,072	-	0
Sub Total	174,386	-	0
Management Reports			
Alphanumeric	5,992	-	0
Graphic	0	-	0
Sub Total	5,992	-	0
Total	134,783	5.3	7,106

4.3 Data Volume Capacity

Generalized data management software systems, DMS and DBMS, require more storage capacity than the Traditional Application Systems because of their additional capabilities. Data for extremely large applications may not fit under either DMS or DBMS approach because limited storage areas supporting implemented system.

The Traditional Application Approach is most effective when:

- Small or medium data files are needed.
- Extremely large application data files are needed and no other approach can meet requirements.

The DMS approach is most effective when small or medium data files are needed.

The DBMS approach is most effective when medium to large data files are needed.

The FEDSIM Alternatives Analysis (4) lists files and data storage requirements which are summarized here. Several DBMSs reviewed have capacities exceeding two billion records. With a single copy of the national ALMRS data base requiring 179 Gigabytes, approximately 1.3 billion records of 130 characters would be required. Therefore the DBMS approach is acceptable, although performance questions need examination.

Table 4.6 ALMRS Data Files and Base Storage Requirements (1997)
(4) pages 95-101, 129, 295-310

Data Files	Source	No. of Data Elements	File Size - Million Char Base	Growth Year	Percent Updated/Year	Update Characters
Land Description	Title Plats, Cad. Survey	20	690	—	1.0	6.9
Ownership & Status	Land Records	115	18,000	338	0.05	9.0
Active Case Files	Cases, e.g., Case Rec.	115	4,360	+3.5%	10.0	436.0
Serial Number Log	Computed from Ownership log	2	0.12	—	30.0	0.0
Stipulations	Stips by land description, Area Office	16	820	—	2.5	20.5
Regulation References	Regulations	1	1,000	—	0.5	5
Master Name	Case Data	15	560	+2%	1.0	5.6
Total Alphanumeric (A/N)			24,450	—		483
Geographic Coordinates (Unstructured, GR) - Adjust, Surv., USGS		60	153,571	—	0.01	1.53
Total A/N and GR Single Copy National			179,001	Weight Pct.	0.035	63.6

Totals with duplication for data base colocation

Alphanumeric	150,321	
Graphic	387,532	
Total	537,853	(538 Gigabytes)

4.4 Data Structures

Several types of data structures can be used to define data relationships of data within and among different data records.

The Traditional Application System is most effective when:

- Data files have complex structures within and among records.
- Query and report processing do not require combination of data files.

The DMS approach is most effective when:

- Less structuring capabilities than the Traditional approach are needed within a record.
- Less complex structuring is needed among records.
- Generally provides a restructured subset of DBMS approach for within and between records due to resource limitations.

The DBMS approach is most effective when:

- Processing requirement include complex structuring capabilities among two or more record types to support queries and reports.
- Supports hierarchical and network structures among records.
- Dynamic creation of relationships among records such as joining and subsetting record types.

Data base relationships (interrecord) are a major requirement for ALMRS and dynamic creation of colocation of relationships "on-the-fly" will be required frequently.

4.5 Staffing

Experience and quantity of personnel required varies by data management approach.

The Traditional Application is most effective when:

- An adequate supply of programmers and system support personnel is available during development and maintenance or can be acquired.

The DMS approach is most effective when:

- Skilled DMS specialists are available or acquired.
- Professional programmers are limited and development can and queries can be shifted to users.
- Users can be satisfied by reports in general format rather than precisely formatted.
- Users are willing to formulate their own queries and reports via an English-like query and reporting facility.

The DBMS approach is most effective when:

- Skilled DBMS specialists are available, or can be developed from present staff, or acquired under contract.
- Users are willing to formulate their own queries and reports via an English-like query and reporting facility.

Present data processing and user community staffing in the BLM tends to reject the Traditional approach and favor DMS and DBMS.

4.6 System and Data Conversion

Conversion is the transport of a computer application from one environment to another while maintaining functional requirements.

ALMRS and GIS applications on a Bureauwide system scale are new automation domains. Only limited and interim automation of land and minerals applications is now operational. Data partially automated for about 2 percent and the cases and related data are not automated. Major new development and data automation is required. Weighting the choice of ALMRS data management approach toward a familiar past environment.

4.7 Summary of Global Factor Screening

Assessment of the preceeding global factors is summarized in Table 4.6, which compares requirements with data management approaches. The Traditional approach is inadequate; Data Management Systems provide a better capability set, but the Data Base Management System approach rates equal or superior for all global screening factors.

Table 4.7 Application of Global Factors as Screens to Selecting a Data Management Approach (7) page 18.

Global Factor For Screening of Alternatives	Summary Estimate of Data Management Approach Alternatives Potential for Meeting ALMRS/ALMRS Prototype requirements			Approach Indicated
	Traditional Application System	Data Management System	Data Base Management System	
4.1 Data Sharing	Requirement: Data Sharing Essential			
	Poor	Fair	Good	DBMS
4.2 Data Use Pattern				
- Output Specs known prior to need	Requirement 56 Percent Known			
	Inadequate	Good	Good	DMS/DBMS
- Mode of Use Interactive	Requirement 98 Percent Accesses Interactive			
	Poor	Good	Good	
- Response Time Required	Requirement: Fast Turnaround and Response			
	Poor	Fair	Good	
- Majority of Access for Retrieval	Requirement: 95 Percent of Accesses for Retrieval			
	Poor	Good	Good	DMS/DBMS
4.3 Data Volume Capacity	Requirement: Large Files			
	Fair	Fair	Good	DMS/DBMS
4.4 Data Structure	Requirements Accommodate Complex and Changing Relationships			
- Complex within record	Good	Fair	Good	DBMS
- Complex between records	Fair	Fair	Good (Need Relational)	DBMS
4.5 Staffing	Requirement: Staff Resources Available			
- DP Staff available	Need many, hi skill	Need fewer, hi skills	Need fewer, hi skill	DBMS
- Users able to use	Poor	Good	Good	DMS/DBMS

Selection of the DBMS approach to meet the ALMRS and GIS prototyping is indicated by this review. The advantages of full relational model for data organization in the DBMS is also evident in comparing user requirements to other data organization models such as network or hierarchial.

A relational DBMS (RDBMS) is adopted for the ALMRS prototype and the LIS demonstration in the prototype paper (1). A RDBMS is more flexible than other types of data base organization (hierarchical and network) and, with a good fourth generation nonprocedural query language, can produce ad hoc queries required by ALMRS (2). The price for these features is possibly slower response times (2); this factor can be mitigated by increasing processor power. Network and hierarchical DBMS inverted lists and indexed sequential files used with random access methods may produce faster results with large data bases using indexes and pointers, and use of a predefined set of relationships which are not easily changed for new relationship conditions.

5. SPECIFIC FACTORS FOR SELECTING DATA MANAGEMENT APPROACH AND SYSTEM

Section 4 considered global factors for selecting a data management approach and included a comparison of ALMRS requirements by factor. The finding in Section 4 is that the Data Base Management System (DBMS) approach is superior for ALMRS and also for GIS applications. The Traditional Application approach is clearly inappropriate and the intermediate Data Management System approach may be adequate. Specific factors in this section can provide significant confirmation of the initial determination. This section will also focus on criteria for selecting a specific DBMS package.

Recall again that the immediate need is to select a DBMS for use with ALMRS prototype activities and with the Farmington Land Information System demonstration. Although plans are incomplete at this time, two views illustrate the range of objectives of these two efforts.

1. Miniature Operational System. This view holds that operational ALMRS functions can be implemented to demonstrate capabilities, verify representative requirements through operational use with actual data and integration of hardware and software components similiar to the proposed actual system.

2. Testing of Requirements Specifications. Several of the user requirements and components of the system configuration need to be tested and contract specifications prepared for subsequent contract development of the full ALMRS system.

The objectives could be one and the same if enough resources, people, computer facilities are available. The real objective then is to:

- Reduce risks such as failing to meet requirements fully.
- Reduce risks inherent on new system configuration design issues such as system portability, new interfaces for alphanumeric and spatial position data and processes.
- Minimize costs.
- Serve a large nonprogrammer user base with interactive on-line service with distributed processors and data bases.

Whereas the FEDSIM ALMRS Alternative Analyses was completed in December 1985, a similiar feasibility analyses for a Bureau Geographic Information System (GIS) application is still in progress. From experience with the ALMRS requirements for graphics and many years of staff experience with GIS requirements and systems, we feel that the data management requirements for ALMRS are applicable to a Bureauwide GIS implementation. Comprehensive data sharing and integration of processes and systems could provide major service and economic benefits throughout the Bureau.

5.1 Hardware Constraints

Prototype Applications

The DBMS selected for the ALMRS-GIS prototype must run on the prototype computers.

An earlier paper, (1) page 1, provides prototype computer specifications as:

- Multiuser and Multiasking
- Word size of 32-bit
- Office environment
- Memory of 1 to 4 Megabytes
- Disk Capacity: Magnetic 404-454 MB

Prototype equipment meeting these specifications was acquired and is now in use in the Project Office, including:

Hewlett-Packard HP9000/320B;

Digital Equipment Corporation DEC Micro VAX II.

A recent hardware request (5) for the Farmington Land Information System demonstration included three computers for the Farmington Office--a Hewlett-Packard under the ALMRS prototype approval and two Prime computers under the Departmentwide GIS procurement contract.

Hewlett-Packard HP9000/560
2 Prime 2450 (Level D)
IBM PC/AT Compatible (16-bit word size), e.g., IBM, Compaq Zenith
2 Apple Macintosh (Plus)

ALMRS and GIS prototype work will involve computers now running the Map Overlay Statistical System (MOSS) and related software. The CPUs, which may be used for software, data conversions, and developing linkages between GIS and DBMS, are listed here with office and city.

Prime 9955 (Level A)	DSC - Denver; NM SO, Santa Fe
Data General MV8000	CO SO - Denver; NPS, Santa Fe
MV4000	DSC - Denver;
IBM PC Compatible	DSC - Denver;

The Alaska State Office expects to acquire a new computer for operation of the Alaska ALMRS pending a merge with ALMRS. Some ALMRS-GIs prototyping may also be done in Anchorage; the likely computers include:

Prime 9750 (Level B)	AK SO - Anchorage
Data General MV 100000	

The ALMRS Alternative Analysis (4) utilized three processor types for alternative configurations and cost analyses. The DBMS selected for prototyping is not required to operate on these machines, but the testing will be to verify ALMRS-GIS operations approximating the specifications set forth in the table that follows.

Table 5.1 - Feasibility Study Processor Types with Representative Models and Use Sites (4) page 127, 373

Use Sites and Requirements	Processor Type		
	A	B	C
Offices Where Used	DSC, SO, and larger DO/AO	Most DO and Independent AO	Sites with Limited Workload
Millions of Instructions per Second (MIPS)	1.5+	0.7+	0.3+
Disk Storage Gigabytes*	16 to 20+	3.8 up to 15+	up to 2
No. of Simultaneous Users	128	50	12
No. of Ports Supported	400	125-150	20-30
Representative Vendors/ Models for Type:	IBM 4381-1 DG MV/10000 DEC VAX 11/785	IBM 4361-4 DG MV8000 DEC VAX 11/750	IBM 4361-3 DG MV4000 DEC VAX 11/730
Undiscounted Unit Cost based upon:	VAX 11/785	VAX 11/750	VAX 11/730
Total Cost	$354,000	$125,000	$75,000
- CPU 2MB Mem., 2 char.	195,000	54,000	21,000
- Additional Memory	(6MB) 24,000	(2MB) 9,000	---
- Additional Channels	(3) 39,000	(1) 7,000	---
- System Temp. Disk, MB	(900) 38,000	(450) 19,000	(450) 19,000
- Tape Drive (and Speed)	(Hi) 25,000	(Lo) 11,000	(Lo) 11,000
- Modem Interfaces	3,000	3,000	3,000
- A/N Terminal Interfaces	12,000	4,000	2,500
- Operator Console	3,000	3,000	3,000
- Software Products	15,000	15,000	15,000

* Single Copy of "Lower 48" States Data: 25.4 Gigabytes alphanumeric
153.6 Gigabytes graphic
Total: 189.0 Gigabytes

Hardware Summary

Representative computers available in six size classes and by vendors cited in protot applications or ALMRS operations sections are shown in Table 5.2. Price, memory, wor and operating systems are shown for comparisons. Candidate data bases should run on one size computer. Some computers are included because they use the desired operatin (see the next section), others because the vendor is represented in adjacent size cla still others, e.g., supercomputers, for comparison only.

Table 5.2 - REPRESENTATIVE COMPUTERS IN SIX SIZE CLASSIFICATIONS (3)

MAINFRAMES						MINICOMPUTERS						MICROCOMPUTERS					
Manufacturer		Price	Memory	Word	Operat.	Manufacturer		Price	Memory	Word	Operating	Manufacturer		Price	Memory	Word	Operat
Page*	Model	Mill. $	Range MB/MIPS	Size *	System	Page*	Model	Thous. $	Range MB/MIPS	Size *	System	Page*	Model	Thou. $	Range MB/MIPS	Size S/T*	System
SUPERCOMPUTERS						HIGH-END MINICOMPUTERS (32+ bit)						HIGH-END MICROCOMPUTERS (32 bit)					
AMDAHL						AT&T						DIGITAL EQUIPMENT CORPORATION					
2, 8	1200	11-20	64-128 /50+	32-128	MVS	15, 32	3B20/A	—	4-16	32	UNIX	62, 76	MicroVAX II	—	2-5	32/32	VMS ULTRIX
						15, 32	3B5/301	44	2-16	32	UNIX						
CRAY						BURROUGHS						HEWLETT-PACKARD					
2, 8	X-MP	5-14	8-64 /50+	64	COS	15, 32	B930	—	.512-3	64	MCP	64, 78	HP200M226	9-11	.128-2	32/16	HP-UX
												—	HP9000M320	150	4	32/32	HP-UX
												64, 79	HP9000M550	—	.512-10	32/32	HP-UX
MAINFRAME COMPUTERS																	
AMDAHL												IBM Instruments (subsidiary of IBM)					
2, 8	5880	4-5	32-128 /23	32	VM MVS,UNIX UTSV							64, 79	S9000 M9003	21	.128-5	32/16	XENIX
BURROUGHS						DATA GENERAL						MICROCOMPUTERS (16 Bit)					
2, 8	A3 Mod D	—	3-6	48	MCP	16, 33	MV10000	150-680	1-16	32	AOS	ATT					
3, 9	B7900 Mod F	2-4	12-96/ 4.4-13.7	48	—	16, 34	MV8000	167-260	1-12	32	AOS, UNIX	87, 119	PC6300	3-6	.128-.640	16/16	XENIX
						16, 34	MV4000 DC	—	2-8	32	AOS, MV/UX						DOS
DIGITAL EQUIPMENT CORP.						DIGITAL EQUIPMENT CORP.						BURROUGHS					
3, 9	DEC 1095	.4-.5	9-18	36	TOPS VA	16, 34	VAX 8600	570-970	12-32	32	UNIX/VMS/ ULTRIX	87, 119	B25	3-31	.256-1	16/16	DOS
3, 9	DEC 2065	.3-.4	9-18	36	TOPS	16, 36	VAX 11/785	195-509	2-32	32	"/"/"						
						16, 34	VAX 11/750	54-213	1-8	32	"/"/"						
						16, 34	VAX 11/730	—	1.5/42	32	"/"/"						
HONEYWELL						HONEYWELL						COMPAQ					XENIX
3, 10	DPS 8/47	.2	4-32	36	GCOS	17, 37	DPS 6/95	100-400	2-16	32	GCOS	89, 122	Deskpro286-1	4	.256-82	16/16	DOS
4, 10	DPS 88/41 DPS 88/90	1.8	16-64	36	GCOS GCOS												
IBM						IBM						DATA GENERAL					
4, 11	3081 K	2.6-3.2	16-64 /15	64	MVS, VM	18, 38	4331-2	—	1-4	32	DOS, VM	91, 124	Desktop 45	—	4	16/16	UNIX
5, 12	4381-1	.35-.74	4-32 /2.5	32	OS, VM DOS	18, 38	S38 5381-7	134-206	2-4	32	CPF	DIGITAL EQUIPMENT CORP.					
						18, 38	8150	115-145	.2-8	32	OS	92, 125	Profes. 350	6-9	.512-1	16/16	XENIX
5, 12	4361-4	.2-.3	2-16	32	OS, MVS DOS, VM												
5, 11	4361-3	—	2-4	32	OS, VSE	PRIME (GIS Procurement: A$105; B$81; C$55; D$23						HEWLETT-PACKARD					
5, 12	S370 148	.4-.5	1-2	32	VM/VMS DOS/VSE	—	2450 "D"	60-90	2-4	32	PRIMOS & PRIMIX	95, 129	Vectra	3-7	.256-3.64	16/16	DOS
5, 12	3090M 400	8.7	128-256	64	MVS, VM	19, 41	9655 "C"	126-153	2-8	32	" "						
						19, 41	9750 "B"	231-258	4-12	32	" "						
						19, 41	9955 "A"	351-561	4-16	32	" "						
						TRADITIONAL MINICOMPUTERS											
						BURROUGHS						HONEYWELL					DOS
						21, 44	B1990 CMS	70	.512-2	24	CMS	96, 130	MicroS 6/10	4-14	.128-1	16/16	GCOS
						DIGITAL EQUIPMENT CORP.						IBM					DOS
						23, 47	PDP 11/70	90	.128-4	16	DSM, VMS	96, 131	PCXT M78	—	.256-.640	16/8	XENIX DOS
						HEWLETT-PACKARD						96, 130	PCAT M99	10	512K-3	16/16	XENIX
						25, 48	HP1000 M19	—	.768-6	16	RTE	ZENITH					DOS
						25, 49	HP3000 M48	—	2-4	21	MPE	111, 149	Z200 Adv PC	4-6	.512-1.5	16/16	XENIX UNIX
						HONEYWELL											
						25, 49	DPS 6/75	—	1-2	16	GCOS						
						IBM											
						25, 50	S/36 M5360	79-100	.128-1.75	16	SSP						
						26, 51	8140/A,B,C	26-90	.5-2	16	DPC						

(3) From: Data Sources, Hardware Volume, First Quarter 1986, Section A Computer Systems
* Word Size in Bits, S/T Storage and Transfer for Microcomputers

The hardware environment constraints are summarized as follows:

Table 5.3 Computers for Prototyping and Operations

(size class assignments from Data Sources [3])

Mainframes Mfg - Model	High-end Minicomputers Mfg - Model	High-end Microcomputers (36-bit) Mfg - Model	Microcomputers (16-bit) Mfg - Model
	Existing for Prototype		
---	---	HP9000/320 DEC Micro VAX II	---
	Farmington Prototype Plan		
---	Prime 2450 (Level D)	HP9000/560	IBM PC-AT Compatible Apple MacPlus
	Additional ALMRS-GIS Prototype		
---	Prime 9955 (Level A) Data General MV10000 Data General MV4000	---	IBM PC Compatible (e.g., IBM, Compaq, Zenith)
	Alaska Prototype		
---	Prime 9750 (Level B) Burroughs (unknown)	---	---
	ALMRS Alternative Analysis - Operational Configurations		
A IBM4381-1	A Data General MV10000 A Digital Equip. Corp. VAX 11/785	---	---
B IBM4361-4	B Data General MV8000 B Digital Equip. Corp. VAX 11/750		
C IBM4361-3	C Data General MV4000 C Digital Equip. Corp. VAX 11/730		

5.2 Software Constraints

Operating System

The major software constraint is the standard operating system being adopted for the ALMRS prototype computers. ALMRS is requiring vendor independence; that is the software must run not only on computers of different sizeclasses but also on computers made by different manufactures.

A common operating system is required to:

- Permit computers bought under different procurements and times to :
  - operate software application systems without conversions, and
  - operate with other brands of computers.
- Be programmable to customize the user interface.

The common operating system chosen for the prototype and advocated for implementation of ALMRS is UNIX (6) page 12. UNIX, developed by Bell Laboratory now runs on all sizes of computers (see Section 5.1).

Software Constraints

Instructions for computers have advanced through several generations from programmer hostile to less hostile and finally toward end-user friendly. Language evolution is producing high level languages requiring fewer command to do given tasks. Third generation languages (3GL) include FORTRAN, C, Pascal and COBOL.

A fourth generation language (4GL) is generally defined as a command set that gives users integrated capabilities including queries, reporting, graphics, statistics and modeling that can be implemented through simple syntax which makes processed data accessible to nonprogramming users.

The large number of nonprogramming users for ALMRS requires that 4GL technology as defined above be utilized in ALMRS and that use and testing occur during prototyping (6) pages 12 and 13. Data must be usable by large numbers of nonprogrammers.

The American National Standard Committee is developing two DBMS Standards (7) p 19:

1. Network Database Language
2. Relational Database Language SQL.

A wide variation of user interfaces is now offered by vendors for making queries, reports and other uses of the data. Adoption of and implementations of known standard(s) which can be related to user skill levels is needed.

5.3 Other Requirements for the ALMRS-GIS Prototype

Some system workload measures were presented in Section 4, but numbers and kinds of users are key to many requirements. Most information access will be by BLM and other Federal agency personnel and public users who are nonprogrammers. This requires "friendly-easy-to-use" user-machine interfaces which involve only limited time for training.

Some 2,220 graphics terminals and 1,880 alphanumeric terminals will be in use at 136 Bureau locations (4) pg 111, (Additional for Alaska). Bureau and public users are shown below. Use by 3,300 users and 100,000 public users and other federal users demands simplicity in a user interface both for efficiency and to avoid excessive training time and cost and avoid high levels of user fustration. Use level data is shown in Tables 5.4 and 5.5.

Objectives for land and mineral programs for ALMRS to provide information retrieval in less time than required now at all Bureau sites. Each office becomes a public room improving public service and reducing costs. Case processing should be expedited. Physical security and integrity of the data, including proprietary data, must be maintained and improved. Growth of workforce levels and costs can be controlled with improved access locations and times through automation of case processing aids, records maintenance and records use (4) page 9.

Implications for DBMS requirements (4) page 9 include:

- Standardization of data, data use, case and data processing.
- All data changes, additions, and updates must be journalized (4) pg 102 and checkpointing is also required (4 pg 104.
- Easy to use interfaces for Bureau and public users.
- Generate reports not now economically possible.
- Resolve present interoffice coordination/data access issues through improved data sharing between data bases and data locations.
- Provide data backup which is not effectively accomplished now.
- Ad hoc (free form) data retrieval under changing data relationship conditions must be provided interactively and on-line.
- Application development tools to facilitate testing of requirements and preparing system development contract specifications..

Table 5.4 Number and Full Time Use Equivalent of Users (1985 level)

	Bureau Users		Transactions					
	Number	Full time	No./Day	No/Year	Avg No./Year		Avg. No. Each of 173 days in FTE WY	
	(4)208,216 224-446	Equivalent (FTE)(4)216	(re Table 5	No/Day X 250	Per User	Per FTE	Per User	Per FTE
Managers (4) pg 224	276	49						
Land & Mineral Personnel (4) Pg208	1,782	1,782						173
Records (4) pg 208	235	235						
Other (4) pg 208	1,009	201						
BLM Total	3,302	2,267	93,973	23,493,250	7,115	9,858	28	60
Public (4) pg 446	100,000	1,735	60,616	15,154,000	151	8,739	1	50
TOTAL	103,302	4,001	154,589	38,647,250	374	12,332	1.5	56

2400 users pending X (5 x 52 - 10 holidays = 250 business days) 600,000 users day at BLM sites.
600,000 user days/estimate 6 day use per user per year = 100,000.
600,000 user days - 4 hours use/user day = 2,400,000 hours/8 hr day = 300,000 user days.
300,000 user days/173 days/workyear 1,734 FTE 1 FTE = 173 day 480 min/day = 83,040 min/yr.

Table 5.5 Input Transactions per day (1985 Base Level)

Function	Alphanumeric	Graphic	Total
1985			
Case Processing (4) pg 332	14,212	1,202	15,413
Management Reporting (4) pg 239	6,000	—	6,000
Query (4) pg 247, 255			
Internal	42,453	30,105	72,558
Public (Exter 17,757 (4) 241)	46,331	14,287	60,618
Total Query	88,784	44,392	133,176
1985 Total	108,998	45,594	154,589
1985			
Case Processing (4) pg 328	21,474	1,816	23,290
Management Reporting (4) pg 239	6,000	—	6,000
Query Total (4)	107,322	67,077	6,000
1997 Total	137,861	68,883	203,689

5.4 Performance and Costs

Performance

Performance measures indicate how responsive the system is to the user. Most applications will provide better performance than a DMS or Traditional Application. Better performance is due to the ability of the DBMS to tune the performance of application by using optimal access methods but independent of the logical structure. DBMS packages usually provide performance measurement facilities to facilitate tuning (7) page 19. High performance is not a crucial requirement for the data management product selected for the prototypes where development tool features will be very important. High performance will be required for the implemented operational ALMRS System. That is, we will require fast processing and response to large numbers of users with large amounts of data at many locations.

Costs

Costs types for three data management approaches are shown (7) page 19.

Table 5.6 Cost Types by Approach

Approach	Non-recurring Costs	Recurring Costs
Traditional Application	- Requirements Analysis - Design Studies - Software Development	- Continuing maintenance and support - Redevelopment for new output products - Continued training/retraining
DMS and DBMS	- Requirements Analysis - Design Studies - Evaluate Vendor Packages - Purchase Package - Prepare Data Base - Installation - Training Users	- Continuing maintenance and user assistance - Continuing rental/lease/ maintenance costs for vendor package - Continued training/retraining

5.5 Maintenance and Data Reorganization

Maintenance is the correction, modification, and enhancement of software to meet user requirements. When resources for maintenance are limited, a DMS and DBMS are usually better since less maintenance coding is required and time for modification is less.

Reorganization is the alteration of the way a data base is organized (structured). Changes in the logical structure and reformatting the physical structure are needed to add an attribute (data element) and change data relationship or data index. Packages using the DBMS approach have facilities for reorganization. The DMS approach usually has very little capability is this area, and the Traditional Approach has none (7) page 20.

5.6 Query Capability and Report Generation

Query

The query capability is the facility available for users to select and retrieve data. Usually English-like phrasing is used with conditional expressions to specify how data is to be retrieved. Some implementations allow the user to combine multiple files in one request.

The DBMS approach has full capabilities, (including Standard Query Language (SQL), SQL-like, QUEL, English-like and menus) DMS usually has fewer capabilities and the Traditional Application approach has no query capability (7) pg 20.

Report Generation

Report generation capability is provided to meet user requirements for reporting. The facility provides data formatting headings, title and footer lines, and sorting. Usually DMS and DBMS approaches provide good report writing capabilities and Traditional Application approach some capability.

5.7 Security and Backup/Recovery

Security

Security is the control of access and use of data and programs to prevent unauthorized use. A DBMS usually provides security facilities to support protection at three levels: data base, file and data element. The DMS and Traditional Approach implementations do not automatically provide security facilities and rely on available operating system protection.

Backup/Recovery

Backup is the creation of a copy of the data base which is saved for use in the event the original is damaged or the system has a failure. Recovery is the process of recovering from a data loss or hardware failure. Using the Traditional Approach, these must be designed in and implemented; DMS and DBMS implementations usually include support facilities for these operations. DBMS implementations generally have operator capabilities. (4) pg 20.

5.8 Data Dictionary

A data dictionary system (DDS) is a computer software system that records, stores and processes information about a system like ALMRS. The DDS contains data on significant data, data concepts, objects, persons, events, data schema and processes. Several DBMS implementations contain a DDS.

The American National Standards Committee is developing dictionary a standard called Information Resource Dictionary System (IRDS) which has three parts: A Dictionary of data, a Dictionary Schema of data structure and a dictionary processing system (command language and menu screens (7) pg 21. The Dictionary of data may approximate the functions of the Bureaus present Data Element Dictionary, i.e., include definitions of attributes, and valid codes and code explanations.

5.9 Business Graphics

Computer Graphics is the ability to output graphic displays and control their appearance. This capability does business graphics, e.g., charts and diagrams. Some DMS and DBMS implementations include facilities with graphics capabilities. The American National standards Committee has proposed a standard called the Graphics Kernel System (GKS) and some DBMS and some DMS implementions have interfaces which can invoke GKS functions. The GKS standard is hardware device-independent.

5.10 Screen Interface

A screen interface is the capability for automated formatting of a CRT screen or display for input or output. Some DMS and many DBMS implementations include interfaces which can be used by application specialists without reliance upon programmers.

5.11 Vendor Support

Vendor support is the assistance provided to the user of a product beyond documentation code and code updates. Use of DMS and DBMS products implies subsequent vendor support such as training data base design and use. The Bureau will probably need to develop/acquire/contract personnel with these skills to serve Bureau sites and control vendor support cost.

5.12 Specific Factor Summary

Application of the specific screening factors to data management approaches to ALMRS-GIS requirements in this Section is summarized in Table 5.7. The result is confirmation M. The selection of the DBMS approach.

Table 5.7 Application of Specific Factors as Screens for selecting a Data Management Approach (7) page 22.

Specific Factor for Screening Alternatives	Summary Estimate of Data Management Approach Alternatives (Potential for Meeting ALMRS/ALMRS Prototype Requirements			Approach Indicated
	Traditional Application System	Data Management System (DMS)	Data Base Management (DBMS)	
5.1 Availability on Hardware				
Mainframe/Mini	Good	Fair	Good	DBMS
Microcomputer	Good	Good	Good	DBMS
Low Resource Utilization	Good	Fair	Fair	Trad.
5.1 Software Constraints				
4 GL/Oper Syst.	Poor	Fair	Good	DBMS
5.3 Performance Cost				
Application tunningation	Fair	Fair	Good	DBMS
Perfor. Monitoring	Poor	Poor	Good	DBMS
Nonrecurring Cost	Fair	Poor	Poor	Trad.
Recurring Cost	Fair	Fair	Fair	—
5.5 Program Maintenance	Fair	Good	Good	DMS/DBMS
Data Reorganization	Poor	Fair	Good	DBMS
5.6 Query Capability	Poor	Fair	Good	DBMS
Report Generation	Fair	Good	Good	DMS/DBMS
5.7 Security	Poor	Poor	Good	DBMS
Backup/Recovery	Poor	Poor	Fair	DBMS
5.8 Data Dictionary	Fair	Fair	Good	DBMS
5.9 Business Graphics				
Standards	Fair	Poor	Fair	Trad/DBMS
Applications	Poor	Fair	Fair	DMS/DBMS
5.10 Screen Interface	Fair	Fair	Good	DBMS
5.11 Vendor Support	Fair	Good	Good	DMS/DBMS

6. EVALUATION OF DBMSs FOR ALMRS-GIS PROTOTYPING

6.1 Comparison

Specific Data Base Management Systems and other selected products have been reviewed based upon published material and interviews. The review included DBMS producted shown in a March 1986 report (8). Other products examined included UNIFY, a RDBMS now used for the prototype activity; INFOCEN, now being used by the Colorado State Office in a GIS data management application; and TECHBASE by MINEsoft, which includes extensive modeling and GIS capabilities.

The ALMRS requirements discussed as global and specific factors descried in Sections 4 and 5 are associated with features and capabilities described as features and capabilities of DBMS products in the Datapro report and shown in 70 columns of a matrix. (A separate Table 6.1A.) The rows in the table are 54 data management products. Availability of features is identified by a pass/fail rating for each product. Twenty-six requirements are rated. Products are shown in order of increasing number of requirements failed.

The pass/fail criteria is used because the available information is inadequate to assign objective scalar values. Information on two important areas can only be inferred from other features. First, the utility of the features to facilitate application development is not available. In lieu of information on development tools, use of a fourth generation language (4GL) and type of data organization model used by the product are used as indicators of ease of development.

The second area where direct evaluation information is lacking is the ease of DBMS use by end users who are nonprogrammers and often first-time or very infrequent users (e.g., individuals doing land and mineral business with the Bureau). Comparisons of different products for ease-of-use by programmers, regular computer package users and nonprogrammer/noncomputer users are very difficult and assessments are clouded with marketing language. The commonly used Standard Query Language (SQL) is not a goof-proof approach.

The requirements are applied to each Data Management product and the number of failed requirements counted. The requirements and a reference to the section where the feature/capability is discussed and low failure rate contenders are abstracted are shown in Table 6.1. The only DBMS product to pass all 26 requirements was ORACLE by the Oracle Corporation; it is recommended for prototype use.

ORACLE has the system development features needed or prototyping work, is comparable in costs with other systems and is available on computers now available for prototyping.

Table 6.1 is a summary of the larger comparison table showing the five leading contenders.

Table 6.1 Comparison Features and Requirements for Prototype Activity: ALMRS-GIS-LIS

REQUIREMENT				NAME OF DATA BASE PRODUCT					No of DB Passing Rqmnts (out of 54)
				FOCUS	INGRES	ORACLE	SIR/DBMS	UNIFY	
Sec.	Reference	Mandatory =	Y No.						
5.0	DBMS		Y 1	Y	Y	Y	Y	Y	54
5.1	Hardware Prototype	HP9000/320	Y 2	—	Y	Y	Y	Y	3
5.1		560	Y 3	—	—	Y	Y	Y	3
5.1		DEC Micro VAX II	Y 4	Y	Y	Y	Y	Y	2
5.1		Prime 2450 "D"	Y 5	—	—	Y	—		1
5.1		9750 "B"	Y 6	—	—	Y	—		1
5.1		9955 "A"	Y 7	—	—	Y	—		1
5.1		IBM PC/AT Compatible	Y 8	Y	Y	Y	Y	Y	1
5.2	Software:								
5.2	Oper. System: UNIX/UNIX-like		Y 9	Y	Y	Y	Y	Y	10
5.2	Fourth General Language		Y 14	Y	Y	Y	Y	Y	15
5.4	Performance:								
5.4	Monitoring with System Accounting		Y 10	Y	Y	Y	Y	Y	46
5.4	Concurrent On-line and Batch		Y 11	Y	Y	Y	Y	Y	48
5.4	Concurrent Appl'n Program Access		Y 12	Y	Y	Y	Y	Y	48
5.5/5.2	Program Maintance:								
	Fourth Generation Language		Y 14	Y	Y	Y	Y	Y	15
5.5/4.7	Data Org/Reorganize: Relational DBMS		Y 13	—	Y	Y	Y	Y	25
		Relation-like	13	Y	—	—	—	—	2
5.6	Query: Data Base Language: SQL		Y 15	—	—	Y	Y	Y	6
5.6		SQL-like	15	Y	Y	—	—	Y	6
5.6	Inquiry Retrieval Facility		Y 16	Y	Y	Y	Y	Y	50
5.6	Report Generator		Y 17	Y	Y	Y	Y	Y	49
5.7	Security		Y 18	Y	Y	Y	Y	Y	50
5.7	Recovery Checkpoint/Restart		Y 19	Y	Y	Y	Y	Y	48
5.7	Logging		Y 20	Y	Y	Y	Y	Y	47
5.8	Data Dictionary		Y 21	Y	Y	Y	Y	Y	45
5.9	Business Graphics Facility		— 22	Y	Y	Y	Y		6
5.10	Screen Interface - 4GL		Y 23	Y	Y	Y	Y	Y	9
4.1	Micro/Mini Link Interface		Y 24	Y	Y	Y	Y	Y	39
4.1	Telecommunications Interface		Y 25	Y	Y	Y	Y	Y	48
4.1	Data Import/Export		Y 26	Y	-	Y	-	Y	6
	Number of Requirements Failed			7	7	0	5	5	

6.2 Costs

The costs at issue for prototype purposes are relevant for a limited number of computer operations. Cost issues are not crucial when the real objective is for testing; reduction of uncertainties; verifying design concepts, performance issues, acceptable user interface procedures, and other technical issues; and resolving subsequent higher procurement quantities. Available cost estimates are included in the comparison matrix and in the Data Base Management System Profile Tables. Costs for the recommended DBMS Oracle appear to be competitive.

Size measures and age of a firm give an indication of service networks, continuity of operations, and financial stability. Selected Data Management System (DMS) are shown in the Table below. Although not crucial for the prototype, continued support by the selected DBMS during ALMRS operations is an important consideration.

Table 6.2 - DATA MANAGEMENT SYSTEM VENDORS
From: Data Sources, Software, First Quarter, 1986, Section 0

Page	FIRM/PHONE	DBMS	ADDRESS	SALES MILL$	NO. EMPL.	YEAR ESTAB.	BUSINESS
76	Henco Software, Inc. (617) 890-8670 Ext. 152	INFO	100 Fifth Avenue Waltham, MA 02154	—	150	1975	Software
82	Information Builders (212) 736-4433	FOCUS	1250 Broadway New York, NY 10001	73	370	1975	Software
96	Logica, Inc. (212) 599-0828	RAPPORT	666 Third Avenue New York, NY 10017	18	200	1977	Software, Consulting
—	MINEsoft, Ltd. (303) 934-8974	TECHBASE	2345 S. Federal Suite 190 Denver, CO 80219-5404	—	5	1985	Software, Consulting
121	Oracle (415) 864-3750	ORACLE	2710 Sand Hill Road Menlo Park, CA 94025	24	250	1977	Software
135	Relational Data Base Systems, Inc. (415) 769-1400	INFORMIX	4100 Bohannon Drive Menlo Park, CA 94025	5	100	1980	Software
135	Relational Technology, Inc. (415) 322-4100	INGRESS	1080 Marina Village Pkwy. Alameda, CA 94501	8	160	1980	Software, Consulting
144	Sir, Inc. (312) 470-9770	SIR/DBMS	5215 Old Orchard Road Skokie, ILL 60077	—	76	1977	Software
167	Unify Corp. (503) 635-6265	UNIFY	4000 Kruse Way Lake Oswago, OR 97034	8	50-99	1980	Software

6.4 Profiles of DMSs and DBMSs

Tabular profiles of selected products are included in this sections for comparison.

TABLE 6.3 - DATA BASE MANAGEMENT SYSTEM PROFILE

VENDOR: Ashton-Tate, Torrance, CA Phone: (213) 329-8000
(Formerly Relational Software, Inc.)

DATA BASE/RELEASE: dBASEIII Plus, Version 1.0

HARDWARE/OPERATING SYSTEM:

IBM PC XT and Compatibles MS-DOS
AT

COMPETITIVE PRODUCTS

Rbase Series 5000
Data Ease

PRICE RANGE:

$400

TYPE:

Programmable Relational Database Management System.

NOTES

- Not available for UNIX Operating System.
- Only available for MS-DOS Operating System.
- Not available for mini and mainframe computer systems.
- Has interface to use "C" language library functions.
- Has menu user interface system.
- Has an internal programming language.
- Has a Local area Network Support System.

TABLE 6.4 - DATA BASE MANAGEMENT SYSTEM PROFILE

VENDOR: Honeywell Information System, Waltham, MA Phone: (617) 895-6000

DATA BASE/RELEASE: DM-IV, 300 I-D-S/II

HARDWARE/OPERATING SYSTEM:

Honeywell DPS 8, GC)S 8

COMPETITIVE PRODUCTS

Cincom Systems TOTAL

PRICE RANGE:

A 5-year license rental ranges from $62,000 to $199,000 depending on options.

TYPE:

Hierarchical/network Data Base Management System.

NOTES

- DM-IV will only run on Honeywell Mainframe Computer System on the GCOS 8 Operating System.
- DM-IV is not available to run on the UNIX Operating System.
- DM-IV has host interfaces for COBOL and FORTRAN.
- DM-IV does not have an interactive user menu interface, except the Transaction Processing System which must be programmed.

TABLE 6.5 - DATA BASE MANAGEMENT SYSTEM PROFILE* - FOCUS

VENDOR: Information Builders, Inc., New York, NY Phone: (212) 736-4433

DATA BASE/RELEASE: FOCUS Version 5.0 Number of user sites: 1,500, plus users
PC FOCUS on remote processing networks (hundreds)

HARDWARE/OPERATING SYSTEM:	
All IBM S/370 and compatibles	MVOS, DOS, VM, OS/VSI
Digital Equipment Corporation VAX Systems	VMS
IBM PC-XT, AT and compatibles	DOS, UNIX

COMPETITIVE PRODUCTS:	
Martin Marietta	RAMIS II
Martin Marietta	NOMAD 2
	FOCUS developed by designers of RAMIS II

PRICE RANGE: $25,800 for Minimum DOS to
$96,900 for Maximum on our VM/370 CMS
$800 for IBM PC-XT, AT
On GSA Schedule

TYPE: Heterogeneous data model consisting of flat files embedded in hierarchical structures; supports full file inversion and relational operations (up to 16 separate data bases, FOCUS and others).

NOTES:

- Bidirectional file transfers between PC and mainframe.
- Interfaces to other data bases.
- Three-level product: DBMS kernel in a Report Writer in an English-like nonprocedural language (prototype of 4GL language group)
- User selections are backed by intelligent defaults.
- User-friendly, English-like nonprocedural control language.
- Comprehensive query and reporting facility including ad hoc queries and custom reports.
- Extensive business graphics capabilities.

*Datapro Research Corporation Data Management Report, SW25-4/6 UL-101, Delray, NJ, 1986, and Auerbach Publishers Data Base Report 620.4098.300, 1985

TABLE 6.6 - DATA BASE MANAGEMENT SYSTEM PROFILE* - INFO

VENDOR: Henco Software, Inc., Waltham, MA Phone: (617) 890-8670

DATA BASE/RELEASE: INFO Version 9.2 1976 Number of user sites: 2,200

HARDWARE/OPERATING SYSTEM:

IBM	
All S/370	VM/CMS
Prime	
150, 9950	PRIMOS
DEC	
VAX 11/730	VMS
VAX 750-782	VMS
Data General	
MV Series	AOS/VS
Honeywell	
DPS/6, Level-6	GCOS
IBM	
PC-XT, PC-AT	DOS

COMPETITIVE PRODUCTS:

Martin Marietta	RAMIS II
Information Builders	FOCUS
Battelle	BASIS
Oracle	ORACLE
Relational Technology	INGRES

PRICE RANGE:

Kernel version license on VAX 11/730	$14,300
Fully configured version on Prime 9955	$83,000
Comparatively low-priced	
On GSA Schedule	

TYPE: Data management application development system with flat file architecture.

NOTES:

- INFO call provides access to programs in COBOL, FORTRAN, PACAL, and PL/1.
- Extremely easy to use.
- Relates data in up to 10 separate files on common data occurences.
- No Data Definition nor Data Manipulation Language (DDL, DML).

*Datapro Research Corporation - Software, Data Management SW30-449LQ-101, Delray, NJ, April 1986

(continued:)

VENDOR: Henco Software, Inc., Waltham, MA Phone: (617) 890-8670

NOTES: (continued)

- Easy for nontechnical and technical users to learn--easy access to data outside INFO.
- Ad hoc retrieval used on key word.
- Runs on wider range of computers than comparable DBMS.
- Query function based on relate and select commands on any item in record. Boolean AND/OR selection available.
- Vendor support lower than ORACLE.

TABLE 6.7 - DATA BASE MANAGEMENT SYSTEM PROFILE* - INGRES

VENDOR: Relational Technology, Inc., Alameda, CA Phone: (415) 769-1400

DATA BASE/RELEASE: INGRES Version 3.0 1981 Number of user sites: 1,000 VAX/VMS 500 MC 68000 UNIX

HARDWARE/OPERATING SYSTEM:

IBM:	
4300	VM/CMS
30XX	VM
All DEC:	
VAX 8600	VMS
VAX 7XX Series	VMS
Micro VAX	Mic VMS
AT&T:	
3B Series	UNIX V
Hewlett-Packard:	
9000	HP UX
Micros MC68000	UNIX V
NCR	
Burroughs	

COMPETITIVE PRODUCTS:

IBM
SQL/DS
Oracle Corporation
ORACLE

PRICE RANGE:

VAX 11/730 license for system kernel $22,500
IBM CMS system along with PCLINK up to $102,000
NOT on GSA schedule

TYPE: RDBMS--originally and totally relational.

NOTES:

- Designed for ease of use by nontechnical and technical users--most functions menu-drive.
- Users can combine concurrent data base access with transaction processing, ad hoc query/update graphics, report generation, and networking.
- Origins--Univ. of California at Berkley

*Datapro Research Corporation Data Management Report, SW25-768TW-101, Delray, NJ, April 1986, and Auerbach Publishers Data Base Report 620.5722.100, 1985

(continued:)

VENDOR: Relational Technology, Inc., Alameda, CA Phone: (415) 769-1400

NOTES: (continued)

- Subsystems include:
  - forms management system
  - form-based report generator
  - full-function report writer
  - an interactive business graphics system
  - an application development system

- Fourth generation tools to enhance capabilities and performance.

- INGRES/NET gives access to remote data bases on DEC computers.

- VAX/UNIX includes:
  Query language (QUEL)
  SQL

- PCLINK query language for data transfers to DIF, Lotus 123

- Versions of INGRES adapted to environment of specific computers--result: INGRES usually outperforms generalized competition in comparable environments.

TABLE 6.8 - DATA BASE MANAGEMENT SYSTEM PROFILE* - ORACLE

VENDOR: Oracle Corporation, Belmont, CA Phone: (415) 598-8000
(Formerly Relational Software, Inc.)

DATA BASE/RELEASE: ORACLE 1979 Number of user sites: 1,500

HARDWARE/OPERATING SYSTEM:

Mainframes:	
IBM S/370 and compatibles	MVS, VM/CMS
Minicomputers:	
DG MV 48 10,000	AOS/VS
DEC VAX 11/725 thru 785	
VAX 8600	VAX/VMS or UNIX V
PDP 11/44 thru 11/70	RSX
AT&T 3B5 and 3B20	UNIX V
IBM 432	VM/CMS
Prime 50 Series	PRIMOS
Microcomputers:	
Hewlett-Packard HP9000/500	HP-UX
IBM PC-XT, PC-AT	DOS
and compatibles	XENIX
e.g., Compaq	
- DEC:	
Micro PDP11/73	RSX/11
Micro VAX	Micro VMS, UNIX V
- ATT 3B2/300	UNIX V
- HP9000/200, 300, 500	UNIX V

All implementations mainframe to microcomputer regardless of configuration are total and not subset.

COMPETITIVE PRODUCTS:

IBM
SQL/DS
Relational Technology, Inc.
INGRES
Micro INGRES
Henco Software
INFO
Information Builders
FOCUS
Cullinet Software
IDMS/R

PRICE RANGE:

Mainframes: up to $144,000
Microcomputers: up to $1,900
Price depends on size of host CPU
On GSA schedule

*Datapro Research Corporation Data Management Report, SW25-685KA-101, Delray, NJ, 1986, and Auerbach Publishers Data Base Report 620.5292.100, 1985

(continued:)

VENDOR: Oracle Corporation, Belmont, CA Phone: (415) 598-8000
(Formerly Relational Software, Inc.)

TYPE: Relational data base management system; free-standing or host-driven

NOTES:

- Pricing of Oracle INGRES and FOCUS for DEC VAX systems is comparable
- ORACLE kernel-integrated data diet
- All-purpose data base language SQL
- Micro to mainframe interface; SQL* link
- Support Options:
  SQL* Graph
  SQL* Calc
  Easy* SQL
  ORACLE* Net (Comm)
  PRO*ORACLE, host language interface
  ORATOR-report writer
- One of best known and fastest growing portable DBMSs
- Portability the result of using C as the development language
- Programs and data are separated, thereby encouraging data distribution in a dispersed environment

TABLE 6.9 - DATA BASE MANAGEMENT SYSTEM PROFILE* - SIR/DBMS

VENDOR: Scientific Information Research, Inc., Skokie, IL Phone: (312) 470-9770

DATA BASE/RELEASE: SIR/DBMS Version 2.2 Number of user sites: 400

HARDWARE/OPERATING SYSTEM:

CRAY	
IBM	
4300	MVS &
30XX	VM/CMS
DEC	
VAX	VMS & UNIX
10	TOPS 10
20	TOPS 20
Honeywell	
DPS8/88	GCOS &
8/90	MULTICS
Level 66	
Prime	
2200	PRIMOS
9900	
Hewlett-Packard	
9000	HP-UX
IBM PC-XT, PC-AT	DOS

COMPETITIVE PRODUCTS:

Oracle Corporation
ORACLE
Relational Technology
INGRES
Advanced Data Systems
DRS
Seed Software
SEED

No head-on competitor

PRICE RANGE:

Microcomputer license as low as $6,000 for single user system.
Minicomputer as low as $20,000 for the first year.
Mainframe highend IBM 30XX version-- $75,000 for the first year.
On GSA schedule.

*Datapro Research Corporation Data Management Report, SW25-JX-101, Delray, NJ, June 1986, and Auerbach Publishers Data Base Report 620.6033.100, 1985

(continued:)

VENDOR: SIR, Inc., Skokie, IL Phone: (312) 470-9770

TYPE: Portable scientific data base management with hierarchical, network, and relational data structuring.

NOTES:

- Uses IBM SQL relational query language as SIR/SQL+ and a screen-oriented language SIR/FORMS.
- Includes a simplified report generator and a sophisticated report generator --both support ad hoc queries.
- Business Graphics module is optional.
- Good analytical/statistics capabilities.
- Import/Export moves data to other computers.
- Not easy to restructure.
- Case/Project oriented.
- Does not provide user with very much free-form expression. Hardware is command-oriented with parameterization.
- Lacks supportive way to read and update external files.
- Lacks interpretative application development package.
- Does permit interfacing with user through a FORTRAN-oriented set of subroutines.

TABLE 6.10- DATA BASE MANAGEMENT SYSTEM PROFILE* - TECHBASE

VENDOR: MINEsoft, Ltd. Denver, CO Phone: (303) 934-8974

DATA BASE/RELEASE: TECHBASE Version 1.3 Number of user sites: 20

HARDWARE/OPERATING SYSTEM:

IBM PC and compatibles	MS-DOS
SUN	UNIX Berkley 4.2
DEC VAX	VMS
Recompile Required (est. 1-4 wks.) for the following:	
HP9000/300, 500	HP-UX
DEC Micro VAX	ULTRIX
Prime	PRIMIX

COMPETITIVE PRODUCTS: ORACLE, UNIFY, etc., and also Geographic Information System elements; no known head-on competitor (HASP SYSTEM)

PRICE RANGE:

		Prototype & Develop. License	12 mo. Mnt.	Prototype	Maint.
Single Copy Prices (25% discount on 2-25)	Super Mini, e.g., PRIME computer PRIMIX	$14,240	$1,424	$5,460	$546
	Super Micro, e.g., HP9000 HP-UX Micro, VAX	$14,240	$1,424	$5,460	$546
	Microcomputer, e.g., IBM PC/AT	$ 7,790	$ 779	$2,030	$203

License includes six months maintenance; later maint. 10 percent/yr.
Lease costs: 13 months, 12 1/2 percent/month; can be cancelled.

TYPE: Relational DBMS plus modeling capability

NOTES:
- Training: $400 Trainer Day
- Includes modeling capability
- Includes GIS capabilities - limited set

*Interview with Michael N. Norred, President, and Peter D. Zuarg, Vice President, MINEsoft, Ltd., by David Nelson and Ellis Monash on July 11, 1986

TABLE 6.11 - DATA BASE MANAGEMENT SYSTEM PROFILE* - UNIFY

VENDOR: Unify Corporation, Lake Oswego, Oregon Phone: (503) 635-6265

DATA BASE/RELEASE: UNIFY Version 3.2 1982 Number of user sites: 15,000

HARDWARE/OPERATING SYSTEM:	IBM	UNIX V, DOS
	AT&T Unix PC, 3B2	UNIX
	NCR	
	Hewlett-Packard	HP-UX
	Honeywell	
	Tandy	
	DEC Micro VAX II	ULTRIX
COMPETITIVE PRODUCTS:	Relational Data Base Systems	Informix-SQL
	Oracle Corporation	ORACLE
PRICE RANGE: Version for:	AT&T Unix PC	$1,495
	AT&T 3B2	$1,995
	IBM PC with MS-DOS	$ 995

TYPE: Form and menu building tools (ACCEL) make it easy to create a complete applications system without a writing code; alternatively the built-in C language preprocessor will link C programs to the data base.

NOTES:

- Menus and forms often cluttered.
- Lacks power in some areas, e.g., language base report writer.
- UNIX products limited to two areas--programmers and turnkey systems.
- User interface-oriented toward a more sophisticated audience than the run-of-the-mill microcomputer data user.
- RPT report writer is actually a report language; includes IF-THEN-ELSE boarding, calculated fields, substring comparisons. Use of a language introduces the possiblity of typos and syntax errors.
- Tutorial--almost a week for data base programmer to go through.
- Data transfer capabilities limited.
- Unify uses UNIX sort command and uses both hashed and B-tree indexes.

*Datapro Research Corporation Data Management Report, CM45-944BE-101, Delray, NJ, May 1986

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(2) Cook, Rick, "Conquering Computer Clutter," in high Technology, Vol. 4, No. 12, page 60, December, 1984

(3) Data Sources, Hardware, Section A Computer Systems, First Quarter 1986

(4) Federal Computer Performance Evaluation and Simulation (FEDSIM) Center, Automated Land and Mineral Record System (ALMRS) Alternative Analysis, Technical Product 84067-DOI, Washington, D.C., December 1985

(5) BLM ALMRS-GIS Project Office, "Farmington, New Mexico BLM Justification of GIS and ALMRS Prototype Equipment from Departmentwide Contract and ALMRS Prototype Approval," Denver Service Center, July 9, 1986

(6) BLM, Memorandum from ALMRS Prototype Systems Manager to ALMRS Staff-- Subject: Policy for Use of Prototype Computers, Denver Service Center, March 9, 1986

(7) U.S. Dept. of Commerce/National Bureau of Standards, Guideline for Choosing a Data Management Approach, FIPS PUB 110, U. S. Government Printing Office, December 11, 1984

(8) Datapro Research Corporation Data Base Management System Report, Delray, New Jersey, March 1986

(9) BLM, Instruction Memorandum No. 86-541 from Director (WO 773) to ADs, SDs, SCD and D-BIFC, Subject Bureau Microcomputer Software Standards Washington, D.C., June 24, 1986.

APPENDIX A

ANALYSIS TABLE

and

ATTENDANCE AT WALKTHROUGH

Table 6.1A Data Management Product Profiles (Y - feature/capability present) (8)

		Part 1						
VENDOR	PRODUCT (incr fail rate sequence)	NUMBER RQMTS FAILED	NO. OF INSTALL 6/86	INIT INSTAL YEAR	DATAPRO REPORT Report No.	DATE	DBMS	
1	2	3	4	5	6	7	8	
Rqmts Sumry Rows 1-4	1 Requirement No.						(1)	
	2 Ref Sec in Rpt						5.0	
Followed by product profile rows	3 Reqmt. Firm						Y	
	4 No Passing Rqmt						54	
Oracle Corp.	ORACLE	0	1700+	1979	SW25-685KA-101	4/86	Y	
Sci. Info R	SIR/DBMS	5	350	1977	SW25-819JX-101	4/86	Y	
Unify Corp	UNIFY	5	25,000	1982	CM45-944BE-101	5/86	Y	
Info. Builders	FOCUS	7	1800	1976	SW25-476UL-101	4/86	Y	
Relat. Tech.	INGRESS	7	900+	1981	SW25-768TW-101	4/86	Y	
Info Data Sys.	INQUIRE/DBMS	8	300+	1969	SW25-472MM-101	4/86	Y	
3CI	INFOCEN	9	100	1983	--	7/86	Y	
Human Computing	MISTRESS	10	600	1980	--		Y	
Peregrine Sys.	PEREGRINE	10	15	1984	--		Y	
Nat. Info. Sys.	ACCENT R	11	170+	1980	SW25-644JN-101	4/86	Y	
Applied Data Re	ADR/DATACOM	11	800+	1974	SW25-063LM-101	4/86	Y	
Computer Assc.	CA-UNIVERSE	11	50	1983	SW25-1870B-101	4/86	Y	
Tominy	DATA BASE-PLUS	11	1000	1978	--		Y	
Control Data	IM/DM	11	--	1985	--		Y	
Henco S/W	INFO	11	2200+	1975	SW30-449LQ-101	4/86	Y	
IBM	SQL/DS	11	--	1980	SW25-504MK-301	4/86	Y	
Battelle	BASIS	12	--	1973	70E-092-01		Y	
Canton Auto Sys	CANTON 1990 MGR	12	80+	1982	--		Y	
United S/W	CLIO	12	550+	1979	--		Y	
IBM	DB 2	12	--	1984	SW25-504MK-101	4/86	Y	
Cullinet	IDMS/R	12	1700	1973	SW25-251MJ-101	4/86	Y	
Century Analy.	M BASE/9	12	75	1984	--		Y	
Appli. S/W	MAGNUM	12	220	1976	--		Y	
D&B Computing	NOMAD 2	12	300+	1975	--		Y	
Martin Marietta	RAMIS II	12	1500	1977	SW25-580MN-101	4/86	Y	
Logica DB	RAPORT	12	275+	1979	--		Y	
MINEsoft Ltd	TECHBASE	12	30	1985	SW25-153MY-101		Y	
S/W AG of NA	ADABAS	13	1600+	1971	SW25-824MM-101	4/86	Y	
Sydney Dataprod	CONQUER INFO	13	10	1982	--		Y	
Burroughs	DMS-II	13	5000+	1974	SW25-117MM-101	4/86	Y	
Nat. Info. Sys.	DPL	13	150+	1975	70E-657-01		Y	
On-line S/W	FREESTYLE	13	200+	1984	--		Y	
Honeywell	IDS/II	13	--	1980	--		Y	
IBM	IMS/VS	13	--	1974	SW25-504MK-201	4/86	Y	
Comp Corp/Amer	MODEL 204	13	250+	1971	70E-195MM-101		Y	
Seed S/W	SEED	13	125+	1977	SW25-803XT-101	4/86	Y	
S/W House	SYSTEM 1022	13	500+	1973	SW25-826GF-101	4/86	Y	
SAS Institute	SYSTEM 2000	13	1000+	1970	SW25-782MM-101	4/86	Y	
Cincom Sys.	TIS	13	100	1979	--	4/86	Y	
Cincom Sys.	TOTAL	13	5800+	1969	70E-153MY-101		Y	
Ashton Tate	dBASE III PLUS	14	150000+	1982	--	6/86	Y	
Digital Equip.	DBMS-10	14	125	1973	70E-384-01		Y	
Digital Equip.	DBMS-20	14	125	1976	70E-384-01		Y	
IBM	DL/I DOS/VS	14	--	1973	70E-504MK-101		Y	
Sperry Corp.	DMS	14	--	1974	70E-0-877-01		Y	
Sperry	DMS 1100	14	--	1971	SW25-846MM-101	4/86	Y	
Control Data	DMS-170	14	--		--		Y	
Univ/Windsor	OASIS	14	5	1975	--		Y	
Shipping Res.	SIBAS	14	45	1974	--		Y	
Consolid. Bus.	DA 1	16	10	1977	--		Y	
Cincom Sys.	ULTRA	18	200		SW25-153MY-201	4/86	Y	
Honeywell	DM-IV	20			SW25-458MM-101	4/86	Y	
Relat Data Base	INFORMIX	24			--		Y	
Boeing	RIM	24			--		Y	

(8)Datapro Research Corp., A Buyers Guide to DBMS/Data Dict. SW10-300AP-101, March 1986; Also Interviews

Table 6.1A Data Management Product Profiles (Y - feature/capability present) (8)

		Part 2															
VENDOR	PRODUCT (incr fail rate sequence)	CPUs WITH UNIX/UNIX-LIKE OPER SYST SELECTED FOR PROTOTYPE: HP 9000 320	HP 9000 560	DEC Mic VAX II	Prime 2450(D)	Prime 9750(8)	Prime 9955(A)	IBM PC/AT	DG MV SERIES 10000	DG MV SERIES 8000	DG MV SERIES 4000	IMPLEMENTATIONS BY SELECTED HDWR VENDORS: DG	DEC	IBM	HP	Prime
1	2	9	10	11	12	13	14	15	16	17	18	19	20	21	22	22
Rqmts Sumry Rows 1-4 1	Requirement No.	(2)	(3)	(4)	(5)	(6)	(7)	(8)								
2	Ref Sec in Rpt	5.1	5.1	5.1	5.1	5.1	5.1	5.1					5.1	5.1	5.1	5.1
Followed by product profile rows 3	Reqmt. Firm	Y	Y	Y	Y	Y	Y	Y								
4	No Passing Rqmt	3	3	3	1	1	1	1								
Oracle Corp.	ORACLE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sci. Info R	SIR/DBMS	Y	Y									Y	Y	Y	Y	Y
Unify Corp	UNIFY	Y	Y	Y									Y	Y	Y	
Info. Builders	FOCUS												Y	Y		
Relat. Tech.	INGRESS												Y	Y	Y	
Info Data Sys.	INQUIRE/DBMS													Y		
3CI	INFOCEN			Y								Y	Y			
Human Computing	MISTRESS												Y	Y		
Peregrine Sys.	PEREGRINE													Y		
Nat. Info. Sys.	ACCENT R												Y			
Applied Data Re	ADR/DATACOM													Y		
Computer Assc.	CA-UNIVERSE													Y		
Tominy	DATA BASE-PLUS											Y	Y	Y		
Control Data	IM/DM															
Henco S/W	INFO												Y	Y		Y
IBM	SQL/DS													Y		
Battelle	BASIS												Y	Y		Y
Canton Auto Sys	CANTON 1990 MGR													Y		
United S/W	CLIO												Y	Y		
IBM	DB 2													Y		
Cullinet	IDMS/R													Y		
Century Analy.	M BASE/9															
Appli. S/W	MAGNUM												Y			
D&B Computing	NOMAD 2													Y		
Martin Marietta	RAMIS II													Y		
Logica DB	RAPORT											Y	Y	Y		Y
MINEsoft Ltd	TECHBASE												Y	Y		
S/W AG of NA	ADABAS												Y	Y		
Sydney Dataprod	CONQUER INFO													Y		
Burroughs	DMS-II															
Nat. Info. Sys.	DPL												Y			
On-line S/W	FREESTYLE													Y		
Honeywell	IDS/II															
IBM	IMS/VS													Y		
Comp Corp/Amer	MODEL 204													Y		
Seed S/W	SEED												Y	Y		Y
S/W House	SYSTEM 1022												Y			
SAS Institute	SYSTEM 2000													Y		
Cincom Sys.	TIS													Y		
Cincom Sys.	TOTAL											Y	Y	Y		Y
Ashton Tate	dBASE III PLUS													Y		
Digital Equip.	DBMS-10												Y			
Digital Equip.	DBMS-20												Y			
IBM	DL/I DOS/VS													Y		
Sperry Corp.	DMS															
Sperry	DMS 1100															
Control Data	DMS-170															
Univ/Windsor	OASIS													Y		
Shipping Res.	SIBAS												Y	Y		Y
Consolid. Bus.	DA 1													Y		
Cincom Sys.	ULTRA												Y			
Honeywell	DM-IV															
Relat Data Base	INFORMIX															
Boeing	RIM											Y	Y	Y		Y

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Table 6.1A Data Management Product Profiles (Y - feature/capability present) (8)

		Part 3												
VENDOR	PRODUCT (incr fail rate sequence)	IMPLEMENTATION BY CPU SIZE: Main Frame	MINI 32	MINI <32	MICRO 32	MICRO 16	UNIX: Oper Syst	UNIX IMPL. BY CPU SIZE: Main Frame	MINI 32	MINI <32	MICRO 32	MICRO 16	SYSTEM MONIT ACCTNG
1	2	23	24	25	26	27	28	29	30	31	32	33	34
Rqmts Sumry 1 Rows 1-4	Requirement No.						(9)						(10)
2	Ref Sec in Rpt						5.2		5.1,5.2		5.1,5.2	5.1,5.2	5.4
Followed by product profile rows 3	Reqmt. Firm						Y						Y
4	No Passing Rqmt						10						47
Oracle Corp.	ORACLE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sci. Info R	SIR/DBMS	Y	Y		Y		Y	Y	Y		Y		Y
Unify Corp	UNIFY		Y		Y	Y	Y		Y		Y	Y	Y
Info. Builders	FOCUS	Y	Y			Y	Y				Y	Y	Y
Relat. Tech.	INGRESS	Y	Y		Y		Y				Y		Y
Info Data Sys.	INQUIRE/DBMS	Y	Y										Y
3CI	INFOCEN		Y		Y		Y		Y				Y
Human Computing	MISTRESS	Y	Y	Y		Y	Y					Y	Y
Peregrine Sys.	PEREGRINE	Y	Y			Y	Y				Y	Y	Y
Nat. Info. Sys.	ACCENT R	Y	Y										Y
Applied Data Re	ADR/DATACOM					Y							Y
Computer Assc.	CA-UNIVERSE	Y				Y							Y
Tominy	DATA BASE-PLUS	Y	Y			Y	Y					Y	Y
Control Data	IM/DM	Y											Y
Henco S/W	INFO	Y	Y				Y						Y
IBM	SQL/DS	Y	Y			Y							Y
Battelle	BASIS	Y	Y			Y							Y
Canton Auto Sys	CANTON 1990 MGR	Y	Y			Y							Y
United S/W	CLIO	Y	Y			Y							
IBM	DB 2	Y											Y
Cullinet	IDMS/R	Y	Y			Y							Y
Century Analy.	M BASE/9	Y	Y										Y
Appli. S/W	MAGNUM	Y		Y									Y
D&B Computing	NOMAD 2	Y	Y			Y							Y
Martin Marietta	RAMIS II	Y	Y	Y		Y							Y
Logica DB	RAPORT	Y	Y										Y
MINEsoft Ltd	TECHBASE	Y	Y		Y	Y							
S/W AG of NA	ADABAS	Y	Y			Y							Y
Sydney Dataprod	CONQUER INFO	Y	Y			Y							Y
Burroughs	DMS-II	Y											Y
Nat. Info. Sys.	DPL	Y											Y
On-line S/W	FREESTYLE	Y	Y										Y
Honeywell	IDS/II	Y	Y										Y
IBM	IMS/VS	Y	Y										Y
Comp Corp/Amer	MODEL 204	Y	Y			Y							Y
Seed S/W	SEED	Y	Y	Y									Y
S/W House	SYSTEM 1022	Y	Y			Y							Y
SAS Institute	SYSTEM 2000	Y	Y			Y							Y
Cincom Sys.	TIS	Y	Y										Y
Cincom Sys.	TOTAL	Y	Y										Y
Ashton Tate	dBASE III PLUS					Y						Y	
Digital Equip.	DBMS-10	Y											Y
Digital Equip.	DBMS-20	Y											Y
IBM	DL/I DOS/VS	Y	Y										Y
Sperry Corp.	DMS	Y											Y
Sperry	DMS 1100	Y											Y
Control Data	DMS-170	Y											Y
Univ/Windsor	OASIS	Y	Y			Y							Y
Shipping Res.	SIBAS	Y	Y										Y
Consolid. Bus.	DA 1	Y	Y			Y							Y
Cincom Sys.	ULTRA		Y										
Honeywell	DM-IV	Y											
Relat Data Base	INFORMIX	Y	Y			Y							
Boeing	RIM	Y	Y			Y							

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Table 6.1A Data Management Product Profiles (Y - feature/capability present) (8)

Part 4

VENDOR	PRODUCT (incr fail rate sequence)	CONCURRENT OPER Batch/ Online	CONCURRENT OPER Apln Pgm Access	DATA ORGANIZAT Rel,Ntwk,Hir,Inv 01	02	03	04	APPLN LANGUAGE - HLI 3 GL For	C	Pas	Oth	4 GL	DATA BASE QUERY LANGUAGE SQL-LIKE SQL	QUEL	ENG	DDL	DML	OTH
1	2	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Rqmts Sumry 1 Rows 1-4	Requirement No.	(11)	(12)	(13)								(14)	(15)	(15)	(15)			
2	Ref Sec in Rpt	5.4	5.4	5.5								5.5,5.2	5.6	5.6	5.6			
Followed by product profile rows 3	Reqmt. Firm	Y	Y	Y								Y	Y	Y	Y			
4	No Passing Rqmt	49	50	28								16	6	2	4			
Oracle Corp.	ORACLE	Y	Y	R				F	C	P	Y	Y	SQL					
Sci. Info R	SIR/DBMS	Y	Y	R	H	N		F				Y	SQL					OTH
Unify Corp	UNIFY		Y	R								Y	SQL					
Info. Builders	FOCUS	Y	Y	H	N	R		F	C	P	Y	Y			ENG			OTH
Relat. Tech.	INGRESS	Y	Y	R				F	C	P		Y		QUEL				
Info Data Sys.	INQUIRE/DBMS	Y	Y	R				F				Y						OTH
3CI	INFOCEN	Y	Y	R				F	C	P	Y	Y						OTH
Human Computing	MISTRESS	Y	Y	R	N	H		F	C	P			SQL					OTH
Peregrine Sys.	PEREGRINE	Y	Y	R	N			F	C			Y						OTH
Nat. Info. Sys.	ACCENT R	Y	Y	R	N	H		F				Y						OTH
Applied Data Re	ADR/DATACOM	Y	Y	R	I						Y	Y						OTH
Computer Assc.	CA-UNIVERSE	Y	Y	R					C					QUEL				OTH
Tominy	DATA BASE-PLUS	Y	Y	R	N	H			C	P						DDL	DML	
Control Data	IM/DM	Y	Y	R	N	H		F				Y					DML	OTH
Henco S/W	INFO	Y	Y	R				F	C	P						DDL	DML	
IBM	SQL/DS	Y	Y	R									SQL					OTH
Battelle	BASIS	Y	Y	R	N	H		F								DDL		
Canton Auto Sys	CANTON 1990 MGR	Y	Y	R	N	H										DDL	DML	
United S/W	CLIO	Y	Y	R	N	H	IL	F							ENG			OTH
IBM	DB 2	Y	Y	R				F					SQL					
Cullinet	IDMS/R	Y	Y	R	IL	N	H	F								DDL	DML	
Century Analy.	M BASE/9	Y	Y	R														OTH
Appli. S/W	MAGNUM	Y	Y	R				F									DML	OTH
D&B Computing	NOMAD 2	Y	Y	R	H			F				Y						OTH
Martin Marietta	RAMIS II	Y	Y	H	N	R		F				Y						OTH
Logica DB	RAPORT	Y	Y	R	N	H		F	C	P						DDL	DML	
MINEsoft Ltd	TECHBASE	Y	Y	R								Y						
S/W AG of NA	ADABAS	Y	Y	N	I			F										OTH
Sydney Dataprod	CONQUER INFO	Y	Y	R							Y				ENG			OTH
Burroughs	DMS-II	Y	Y	N	R	H		F										OTH
Nat. Info. Sys.	DPL	Y	Y	H	N			F										OTH
On-line S/W	FREESTYLE	Y	Y	I														OTH
Honeywell	IDS/II	Y	Y	H	N	IS										DDL	DML	
IBM	IMS/VS	Y	Y	H														OTH
Comp Corp/Amer	MODEL 204	Y	Y	N	H	R		F										OTH
Seed S/W	SEED	Y	Y	N	R	H		F		P						DDL	DML	
S/W House	SYSTEM 1022	Y	Y	R	N	H		F										OTH
SAS Institute	SYSTEM 2000	Y	Y	H	N	R		F										OTH
Cincom Sys.	TIS	Y	Y	N		R		F										OTH
Cincom Sys.	TOTAL	Y	Y	N	H			F		P						DDL	DML	
Ashton Tate	dBASE III PLUS			R	H				C			Y			ENG			
Digital Equip.	DBMS-10	Y	Y	H	N			F								DDL	DML	
Digital Equip.	DBMS-20	Y	Y	N	H			F								DDL	DML	
IBM	DL/I DOS/VS	Y	Y	H														OTH
Sperry Corp.	DMS	Y	Y	N	H											DDL	DML	
Sperry	DMS 1100	Y	Y	N	H			F								DDL	DML	
Control Data	DMS-170	Y	Y	N	H	R		F	C							DDL	DML	
Univ/Windsor	OASIS	Y	Y	H				F				Y						OTH
Shipping Res.	SIBAS	Y	Y	H	N	R		F								DDL	DML	
Consolid. Bus.	DA 1	Y	Y	I							Y							
Cincom Sys.	ULTRA	Y	Y	n	R			F									DML	
Honeywell	DM-IV			H				F	C									OTH
Relat Data Base	INFORMIX																	
Boeing	RIM							F		P	Y							OTH

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Table 6.1A Data Management Product Profiles (Y - feature/capability present) (8)

Part 5

VENDOR	PRODUCT (incr fail rate sequence)	INQRY/RTVL FACITITY Y/N	INQRY/RTVL FACITITY Notes	REPORT GENERATOR Y/N	REPORT GENERATOR Notes	SECURITY FACIL. Y/N	RECOVERY Ck Pt Restart	RECOVERY Log/ Audt	DATA DICTIONARY Y/N	DATA DICTIONARY Notes	BUS. GRAPH Y/N
1	2	52	53	54	55	56	57	58	59	60	61
Rqmts Sumry Rows 1-4 1	Requirement No.	(16)		(17)		(18)	(19)	(20)	(21)		(22)
2	Ref Sec in Rpt	5.6		5.6		5.7	5.7	5.7	5.8		5.9
Followed by product profile rows 3	Reqmt. Firm	Y		Y		Y	Y	Y	Y		Y
4	No Passing Rqmt	51		50		51	49	47	46		7
Oracle Corp.	ORACLE	Y		Y		Y	Y	Y	Y	Integ DD	Y
Sci. Info R	SIR/DBMS	Y		Y	Smpl,Cmpl	Y	Y	Y	Y		Y
Unify Corp	UNIFY	Y		Y		Y	Y	Y	Y		
Info. Builders	FOCUS	Y		Y	RPT/QUERY	Y	Y	Y	Y	FDD	Y
Relat. Tech.	INGRESS	Y	QUEL	Y		Y	Y	Y	Y		Y
Info Data Sys.	INQUIRE/DBMS	Y	User Lang	Y		Y	Y	Y	Y		Y
3CI	INFOCEN	Y		Y		Y	Y		Y		Y
Human Computing	MISTRESS	Y		Y	Convers	Y	Y	Y	Y		
Peregrine Sys.	PEREGRINE	Y	QByExamp	Y		Y	Y	Y	Y	InlineDD	
Nat. Info. Sys.	ACCENT R	Y		Y		Y	Y	Y	Y		
Applied Data Re	ADR/DATACOM	Y	ADR	Y		Y	Y	Y	Y		
Computer Assc.	CA-UNIVERSE	Y		Y		Y	Y	Y	Y	Interg	
Tominy	DATA BASE-PLUS	Y	Qu/Rpt Wr	Y			Y	Y	Y	DDL	
Control Data	IM/DM	Y	4GL FQM	Y	4GL/RW	Y	Y	Y	Y	In-Line	
Henco S/W	INFO	Y		Y		Y	Y	Y	Y	DDL	
IBM	SQL/DS	Y		Y		Y	Y	Y	Y		
Battelle	BASIS	Y	Basis QL	Y	DDL	Y	Y	Y	Y	DDL	
Canton Auto Sys	CANTON 1990 MGR	Y		Y		Y	Y	Y	Y	DDL	
United S/W	CLIO	Y		Y		Y	Y	Y	Y	DDL	
IBM	DB 2	Y	QMF,DB2	Y	QMF	Y	Y	Y	Y	IMS DD	
Cullinet	IDMS/R	Y	OLQ	Y	RPG II	Y	Y	Y	Y	IDD	
Century Analy.	M BASE/9	Y	Query	Y	Query	Y	Y	Y	Y		
Appli. S/W	MAGNUM	Y	Interact	Y	IRF	Y	Y	Y	Y	Integrate	
D&B Computing	NOMAD 2	Y		Y		Y	Y	Y	Y	Pasv/Actv	
Martin Marietta	RAMIS II	Y		Y		Y	Y	Y	Y		
Logica DB	RAPORT	Y		Y		Y	Y	Y	Y	DDL	
MINEsoft Ltd	TECHBASE	Y		Y		Y	Y	Y		Some	
S/W AG of NA	ADABAS	Y		Y		Y	Y	Y	Y		
Sydney Dataprod	CONQUER INFO	Y		Y	Interact	Y			Y		Y
Burroughs	DMS-II	Y	DMS	Y		Y	Y	Y	Y		
Nat. Info. Sys.	DPL	Y		Y		Y	Y	Y	Y	DBD	
On-line S/W	FREESTYLE	Y	Exec-retv	Y	Executr.	Y	Y	Y	Y	DD,UD	
Honeywell	IDS/II	Y	PDQ,IFQ	Y		Y	Y	Y	Y	DDL	
IBM	IMS/VS	Y	GIS, IQF	Y		Y	Y	Y	Y	IMS	
Comp Corp/Amer	MODEL 204	Y	User	Y	User(2)	Y	Y	Y	Y		
Seed S/W	SEED	Y	Harv QL	Y	Bloom	Y	Y	Y	Y	DDL	
S/W House	SYSTEM 1022	Y		Y		Y	Y	Y			
SAS Institute	SYSTEM 2000	Y	Quex	Y		Y	Y	Y	Y	Integ DD	
Cincom Sys.	TIS	Y	TIS	Y		Y	Y	Y	Y	Integ DD	
Cincom Sys.	TOTAL	Y		Y		Y	Y	Y	Y		
Ashton Tate	dBASE III PLUS	Y	Menu	Y	Menu	Y		N	Y	Limited	
Digital Equip.	DBMS-10	Y	IQL	Y	Cobol	Y	Y	Y	Y	DDL	
Digital Equip.	DBMS-20	Y	IQL	Y	Cobol	Y	Y	Y			
IBM	DL/I DOS/VS	Y	w Opt Pgm	Y		Y	Y	Y	Y	DL/1	
Sperry Corp.	DMS	Y	Unique	Y	Cobol	Y	Y	Y	Y	DDL	
Sperry	DMS 1100	Y	QLP	Y	Cobol	Y	Y	Y	Y	DDL	
Control Data	DMS-170	Y	Qu/Upd	Y		Y	Y	Y	Y	DDL	
Univ/Windsor	OASIS	Y		Y		Y	Y	Y			
Shipping Res.	SIBAS	Y		Y		Y	Y	Y		DDL	
Consolid. Bus.	DA 1	Y				Y	Y	Y			
Cincom Sys.	ULTRA	Y	Nonpgmr			Y	Y		Y		
Honeywell	DM-IV			Y		Y			Y		
Relat Data Base	INFORMIX										
Boeing	RIM										

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Table 6.1A Data Management Product Profiles (Y - feature/capability present) (8)

		Part 6							
VENDOR	PRODUCT (incr fail rate sequence)	SCREEN GENERATOR	MICRO MINI LNK INTERFAC	TELECOM INTERFACE Y/N	Notes	DATA IMPORT/ EXPORT	BASIC PRICE Low	High	Notes
1	2	62	63	64	65	66	67	68	69
Rqmts Sumry Rows 1-4 1	Requirement No.	(23)	(24)	(25)		(26)			
2	Ref Sec in Rpt	5.10	4.1	4.1		4.1			
Followed by product profile rows 3	Reqmt. Firm	Y	Y	Y		Y			
4	No Passing Rqmt	10	39	48		7			
Oracle Corp.	ORACLE	Y	Y	Y	OS	Y	6,000	144,000	
Sci. Info R	SIR/DBMS	Y	Y	Y			6,000	60,000	WO GOV DC
Unify Corp	UNIFY	Y	Y	Y		Y			
Info. Builders	FOCUS	Y	Y	Y	(4)	Y	46,000		
Relat. Tech.	INGRESS	Y	Y	Y	(OS)				VARIES
Info Data Sys.	INQUIRE/DBMS	Y	Y	Y		Y	77,000	132,000	
3CI	INFOCEN	Y				Y	8,900	54,000	
Human Computing	MISTRESS		Y	Y			800	27,000	
Peregrine Sys.	PEREGRINE		Y	Y			1,000	38,000	
Nat. Info. Sys.	ACCENT R		Y	Y			20,000	52,000	
Applied Data Re	ADR/DATACOM		Y	Y			85,000		DOS
Computer Assc.	CA-UNIVERSE		Y	Y	(3)		100,000		DOS
Tominy	DATA BASE-PLUS	Y	Y	Y	(2)		20,000	65,000	MF
Control Data	IM/DM		Y	Y			23,500		
Henco S/W	INFO		Y	Y			9,800	25,000	
IBM	SQL/DS		Y	Y	(2)		324	434	PER/MON
Battelle	BASIS		Y	Y			38,000		
Canton Auto Sys	CANTON 1990 MGR		Y	Y			210,000		
United S/W	CLIO		Y	Y	(2)		70,000	90,000	
IBM	DB 2			Y	(3)		15,000		
Cullinet	IDMS/R		Y	Y	(4)		65,000	300,000	
Century Analy.	M BASE/9		Y	Y			25,500		
Appli. S/W	MAGNUM		Y	Y					VARIES
D&B Computing	NOMAD 2			Y			130,000		1ST COPY
Martin Marietta	RAMIS II		Y	Y	(5)		45,000	90,000	
Logica DB	RAPORT		Y	Y	PROP		8,500	9,800	
MINEsoft Ltd	TECHBASE	Y	Y	Y					
S/W AG of NA	ADABAS		Y	Y	(4+)		106,000	142,000	MF
Sydney Dataprod	CONQUER INFO		Y				35,000		
Burroughs	DMS-II		Y	Y			13,000	33,626	
Nat. Info. Sys.	DPL		Y	Y	OS		42,000	65,000	
On-line S/W	FREESTYLE		Y	Y			20,000	30,000	OS DOS
Honeywell	IDS/II		Y	Y	(4)		4,365	7,965	
IBM	IMS/VS		Y	Y	(2)		1,265	1,685	PER/MON
Comp Corp/Amer	MODEL 204		Y	Y	(4)		150,000	235,000	
Seed S/W	SEED		Y	Y	(2)		12,000	85,000	
S/W House	SYSTEM 1022		Y	Y			22,500	64,000	
SAS Institute	SYSTEM 2000		Y	Y	(4)		12,000		
Cincom Sys.	TIS		Y	Y			150,000		
Cincom Sys.	TOTAL		Y	Y			13,500	79,500	
Ashton Tate	dBASE III PLUS	Y		Y		Y	400	500	
Digital Equip.	DBMS-10			Y	(2)		6,000		
Digital Equip.	DBMS-20		Y	Y	OS		6,000		
IBM	DL/I DOS/VS			Y			322	429	PER/MON
Sperry Corp.	DMS			Y					VARIES
Sperry	DMS 1100			Y					VARIES
Control Data	DMS-170			Y			11,798	91,891	
Univ/Windsor	OASIS			Y	PROP		30,000		
Shipping Res.	SIBAS		Y	Y					VARIES
Consolid. Bus.	DA 1			Y	(3)		16,750		
Cincom Sys.	ULTRA						51,000	89.000	
Honeywell	DM-IV					Y			
Relat Data Base	INFORMIX								
Boeing	RIM						6,258	8,900	

(8)Datapro Research Corp., A Buyers Guide to DBMS/Data Dict. SW10-000AP-101, March 1986; Also Interviews

Table 6.1A Data Management Product Profiles (Y - feature/capability present) (8)

		Part 7
VENDOR	PRODUCT (incr fail rate sequence)	COMMENTS
1	2	70
Rqmts Sumry Rows 1-4 1	Requirement No.	
2	Ref Sec in Rpt	
Followed by product profile rows 3	Reqmt. Firm	
4	No Passing Rqmt	
Oracle Corp.	ORACLE	4 GL APPLIC MGMT SYS. FOR IMPLEMENTING SYSTEM
Sci. Info R	SIR/DBMS	SUPPORTS ANALYTICAL OPER, USES SIR/SQL+
Unify Corp	UNIFY	
Info. Builders	FOCUS	RELATIONAL FEATURES
Relat. Tech.	INGRESS	DB ACCESS, ISAM, HEAP, SORTED HEAP, B-TREE, QU BY FORM
Info Data Sys.	INQUIRE/DBMS	MULTI DB PROCESSING SUPPORTED, ORGAN RELAT-LIKE
3CI	INFOCEN	QUERY LANG. IS NSQL - LIKE SQL BUT WITH PROMPTS
Human Computing	MISTRESS	NCR MAINFRAMES
Peregrine Sys.	PEREGRINE	4 GL NONPROCEDURAL FOR PROGRAMMERS/NON-PROGRAMMERS
Nat. Info. Sys.	ACCENT R	
Applied Data Re	ADR/DATACOM	
Computer Assc.	CA-UNIVERSE	
Tominy	DATA BASE-PLUS	RELATION-LIKE, PORTABLE APLN DEV TOOLS
Control Data	IM/DM	CYBER
Henco S/W	INFO	OPTION INTERACTIVE APPLICATION DEVELOP
IBM	SQL/DS	COMPLEMENTS DL/I
Battelle	BASIS	DDL, DATA DEFINITION LANGUAGE
Canton Auto Sys	CANTON 1990 MGR	
United S/W	CLIO	
IBM	DB 2	DATA DEFINITION CHANGEABLE W/O STOPPING DB2
Cullinet	IDMS/R	
Century Analy.	M BASE/9	RELATIONAL-LIKE, NCR MAINFRAMES
Appli. S/W	MAGNUM	
D&B Computing	NOMAD 2	4 GL DECISION SUPPORT SYSTEM, INTERFACES TO SQL/DS, DB2
Martin Marietta	RAMIS II	AD HOC QUERIES WITHOUT PROGRAMMING
Logica DB	RAPORT	CODASYL NETWORK, SCREEN ORIENTED ALPHA DEVEL.
MINEsoft Ltd	TECHBASE	VENDOR WILL RECOMPILE ON PROTOTYPE CPUs TO MEET UNIX RQM
S/W AG of NA	ADABAS	
Sydney Dataprod	CONQUER INFO	PROP APLN LANG, DESIGN FOR END-USER, NOT PRODUCTION
Burroughs	DMS-II	
Nat. Info. Sys.	DPL	
On-line S/W	FREESTYLE	
Honeywell	IDS/II	ALL ACCESS METH SUPORT BY CODASYL
IBM	IMS/VS	DL/1 REPLACES USER I/O CODING WITH SIMPLER COMMANDS
Comp Corp/Amer	MODEL 204	SUPPORTS UP TO 513 BILLION RECORDS, 30,000 USERS
Seed S/W	SEED	CODASYL. ACCESS: HASHED,CHAINED,SEQL, B-TREE
S/W House	SYSTEM 1022	
SAS Institute	SYSTEM 2000	
Cincom Sys.	TIS	
Cincom Sys.	TOTAL	
Ashton Tate	dBASE III PLUS	OWN LANG. FILETRANS FORM; MSDOS, OPEN ACCESS
Digital Equip.	DBMS-10	CODASYL TYPE DBMS
Digital Equip.	DBMS-20	CODASYL TYPE DBMS
IBM	DL/I DOS/VS	COMPLEMENTS SQL/DS
Sperry Corp.	DMS	CODASYL ORIENTED
Sperry	DMS 1100	CODASYL-LIKE DBMS, SPERRY CPUs
Control Data	DMS-170	CODASYL-LIKE, CYBER CPUs
Univ/Windsor	OASIS	SUPERSET OF IBM's SQL/DS; HAS ON-LINE HELP
Shipping Res.	SIBAS	PORTABLE, RELATIONAL DBMS NETWORK AND HIERARCHIAL STRUCT
Consolid. Bus.	DA 1	
Cincom Sys.	ULTRA	RELATIVELY MOR EXPENSIVE THAN ORACLE OR INGRES
Honeywell	DM-IV	
Relat Data Base	INFORMIX	
Boeing	RIM	

(8)Datapro Research Corp., A Buyers Guide to DBMS/Data Dict. SW10-000AP-101, March 1986; Also Interviews

ATTENDANCE AT WALKTHROUGH

REVIEW OF ALHRS-LIS-GIS PROTOTYPE DATA MANAGEMENT REPORT

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